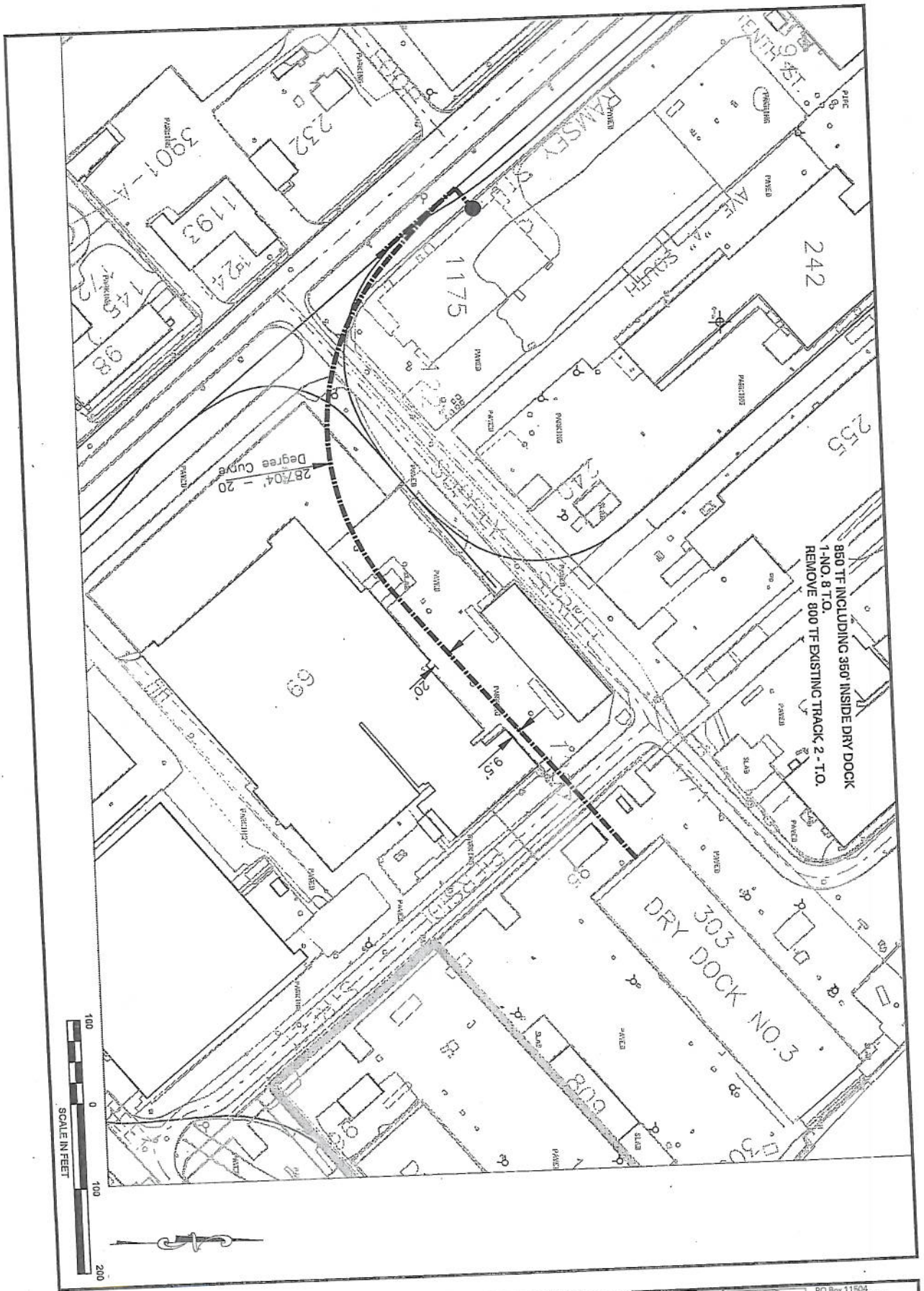
APPENDIX F

RAIL-SPUR EXTENSION ESTIMATES AND DRAWINGS

Bldg. 69 Access
Rail Infrastructure Cost Estimate
Total Length - 0.16 Miles

GENESIS
CONSULTING GROUP

	(New Alignment)				
	Relay 115# RE, 6" Nominal Base Rail, Relay No. 1	T.F.	850	$34.50	$29,325
	New Rail Installation	T.F.	850	$20.00	$17,000
	Ballast, 6" Below Ties	Tons	480	$45.00	$21,614
	Joint Bars - 6 holes (cost included in the rail cost above)	Ea	44		
	Bolts for Joint Bars (cost included in the rail cost above)	Ea	174		
	Tie Plates, Double Shoulder, Relay	Ea	1,000	$3.75	$3,750
	Spikes	Kegs	8	$90.00	$720
	Anchors, New	Ea	349	$1.39	$485
1	**Sub-Total/Cost per Foot Rail and OTM**	T.F.	850	$85.76	$72,894
2	Install Crossties at 21" tie spacing Mainline Ties, Grade 4/5	Ea	486	$45.00	$21,857
3	No. 8 Turnouts (complete with switch stand/switchties)	Ea	2	$20,000.00	$40,000
4	Rail Seals in Asphalt Drives	T.F.	450	$75.00	$33,750
5	Signage	LS	1	$1,000.00	$1,000
	Total - Track Section - New Alignment				$169,501
	Roadbed Construction				
1	Mobilization @ 5%	LS	1	$6,720.72	$6,721
2	Clearing and Demolition within R/W	LS	1.0	$6,000.00	$6,000
3	Soil Stabilization - Foundation System from Dry Dock to Bldg 69A	LS	1.0	$25,000.00	$25,000
4	Remove Track/Turnouts (800 tf and 2-turnouts)	LS	1	$3,500.00	$3,500
5	Grading & Trackbed Construction	C.Y.	3,329	$6.00	$19,973
6	Borrow	C.Y.	2,164	$10.00	$21,638
7	Muck Excavation	C.Y.	1,099	$12.00	$13,182
8	Subballast, 6"	T.F.	850	$28.00	$23,800
9	Derails	Ea	1	$2,000.00	$2,000
10	18" CMP	L.F.	25	$26.00	$650
11	Erosion Control (silt fence, hay bales)	LS	1	$5,000	$5,000
12	Grassing	AC	0.5	$2,500	$1,171
13	Misc. Utility Improvements	LS	1	$10,000	$10,000
14	Field Engineering Layout	LS	1	$2,500	$2,500
	Total - Roadbed Construction				**$141,135**
	Total Construction Cost (Budget Estimate)				**$310,636**
	Total Construction Costs				$310,636
	Contingencies @ 10%				$31,064
	Engineering Design, Surveys, Permitting and Construction Administration @ 8%				$24,851
	Total Project				$366,551



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RAIL ACCESS PLAN

SOUTH CAROLINA PUBLIC RAILWAYS
NAVAL BASE ACCESS - BLDG 69A

NAVAL BASE
CHARLESTON, SC

GENESIS CONSULTING GROUP
PO Box 11504
Columbia, SC 29211
1330 Lady Street, Suite 205
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(803) 744-4500 (Main)
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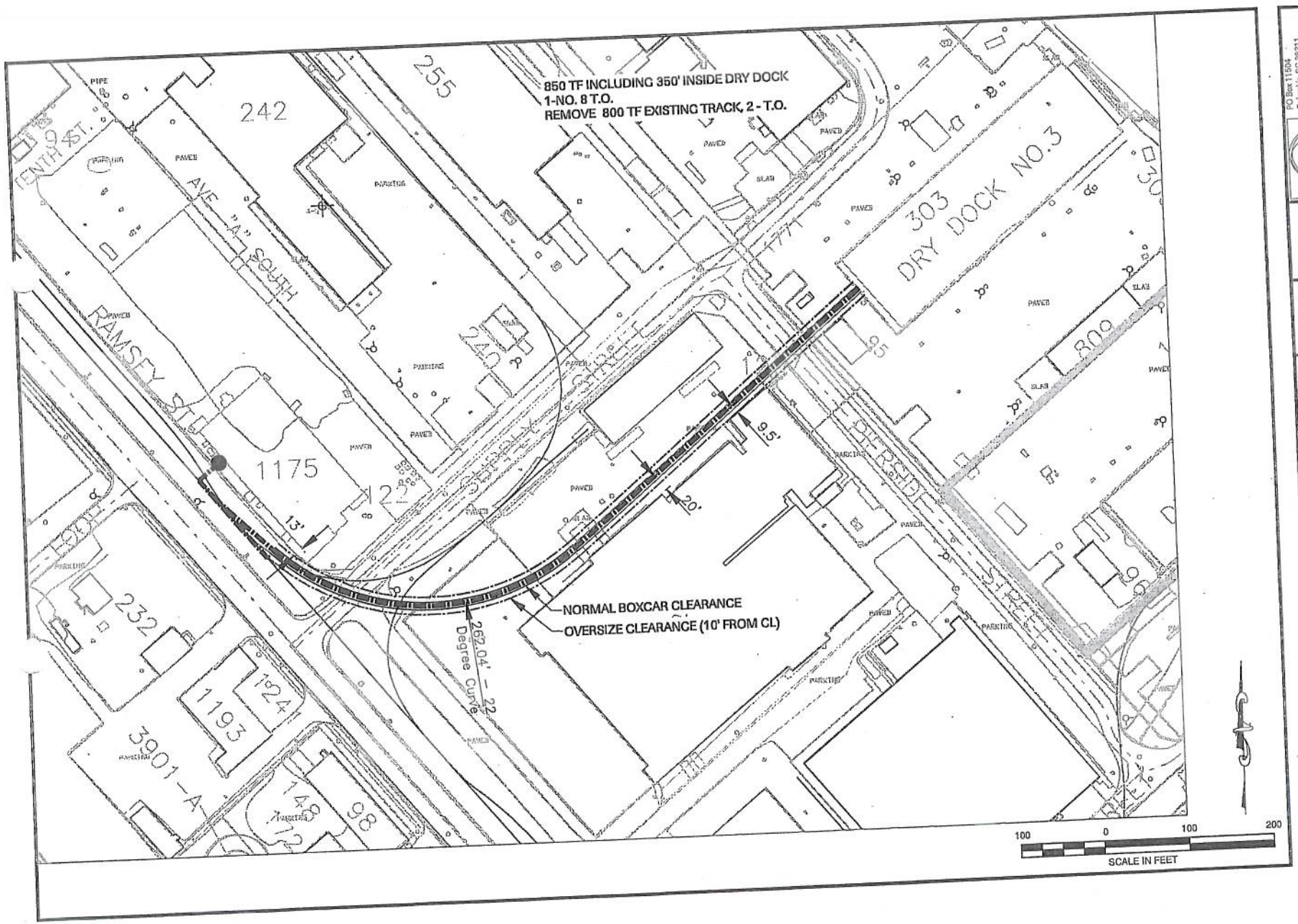
www.genesis-consulting-group.com



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SOUTH CAROLINA PUBLIC RAILWAYS
NAVAL BASE ACCESS - BLDG 69A
NAVAL BASE
CHARLESTON, SC

RAIL ACCESS PLAN

C1.0

APPENDIX G

SRNL DATA ACQUISITION SYSTEM ESTIMATE

Savannah River National Laboratory

Estimate for Data Acquistion and Monitoring Systems

Equipment	Material	Quantity	Procurement	Design/Fab	Integration	Software	Testing	Startup	Subtotal
Emerson Vibration Analysis System	$180,000	2	$10,000	$10,000	$10,000	$20,000	$20,000	$25,000	$455,000
Sensor Link/Fluke Electrical Grid	$160,000	2	$10,000	$10,000	$10,000	$20,000	$20,000	$35,000	$425,000
Monitoring System	$100,000	3	$10,000	$150,000	$50,000	$100,000	$50,000	$50,000	$710,000
Data Acquistion Hardware	$35,000	3	$5,000	$20,000	$20,000	$30,000	$20,000	$20,000	$220,000
Secure Wireless Network	$30,000	1	$3,000	$10,000	$5,000	$5,000	$5,000	$5,000	$63,000
Network Hardware, Fiber Run	$800	5							$4,000
Pressure Sensors	$50,000	1	$5,000						$55,000
Connectors and Cables									
General									
Progject Management									$50,000
Meetings									$20,000
Design Reviews									$20,000
Travel									$25,000

Sub-total	$2,047,000
Contingency	$511,750
Total	$2,558,750
Accreditation (Based on TUV Estimate)	$250,000
SRNL Estimated Budget	$2,808,750

APPENDIX H

SAMPLE WORK PACKAGE TEMPLATE

Work Package Title:	
WBS Number:	
TEP Work Package Number:	
Fiscal Year:	2009

Rev Number:	
Date Prepared:	
Organization:	

Budget Information:

Total Funding

Previous Year Carryover:	$0
Current Year Allocation:	$1
Total:	$1

Planned Expenses

Labor:	$0
Travel:	$0
Materials:	$0
Contracts:	$0
Total:	$0

Work Scope:

(Description of work scope goes here.)

Deliverables:

Deliverable #	Description	Due

BCWS:

Oct-2008	$0
Nov-2008	$0
Dec-2008	$0
Jan-2009	$0
Feb-2009	$0
Mar-2009	$0

Apr-2009	$0
May-2009	$0
Jun-2009	$0
Jul-2009	$0
Aug-2009	$0
Sep-2009	$0

Percent Allocated:	0.00%
Total Allocated:	$0

Submitted by: _____

Control Account Manager: _____

Control Account Manager: _____

Detailed Schedule and Task Budget Allocation (may be accompanied by a graphical schedule)

Task/Sub -Task #	Task Description (If supporting a milestone, link description to milestone listed above)	Start Date (m/d/yyyy)	Finish Date (m/d/yyyy)	Task/Sub-Task Cost ($)

Planned Procurements:
(Identify planned procurements, equipment, supplies, expected costs and approximate schedules)

Staffing Management Plan:
(Identify type of individual(s) (researcher, technician, etc.) assigned to perform work activities, laboratory location, %FTE)

Work Package Risk Register:
(Identify likely risks and catalog probability and impact of occurrence on cost, schedule, scope, or quality. Use qualitative scale of low, medium, high).

APPENDIX I

SAMPLE CHANGE CONTROL REQUEST FORM

Work Package Title	WBS No.	Work Package Number	Fiscal Year
			2009

Request Date:

Organization:

Submitted By:

Type of Requested Changes					
Scope	☐	Schedule	☐	Budget	☐

Changes in Scope

Changes Requested (describe):

Explanation for Requested Changes:

Changes in Schedule

Changes Requested (describe):

Explanation for Requested Changes:

Changes in Budget

Item	Original ($)	Change ($)	New ($)
WP Total			

Explanation for Requested Changes:

Signature of Project Controller:_____ Date:_____

APPENDIX J

US DOD BUILDING 69 ENVIRONMENTAL ASSESSMENT

Summary of Facility No. 69 and 69A

Property Description

Facility 69/69A is a galvanized steel framed, concrete and brick structure that is used as a receiving and shipping transit warehouse. The facility is 82,533 square feet that was constructed in 1942. In 1985 an addition of a steel framed structure with galvanized siding and roof was added (refer to Photo 1).

Facility 69 is used as a shipping and receiving warehouse by Trans-Hold, Inc. Trans-Hold, Inc handles non-hazardous, dry good products. Forklifts used at the facility include diesel, gasoline, and battery powered units. Minor maintenance and repairs for the forklifts is performed on the premises. Major repairs, engine overhauls, and battery repairs are performed off-site. A dual-walled 200-gallon steel AST containing diesel and one-500-gallon equivalent propane AST are associated with the warehouse.

From 1985 to 1995, Facility 69 was the central shipping and receiving warehouse for the CNC. Most of the materials, parts, and machinery purchased for the repair and maintenance of ships, submarines, vehicles, and equipment for the entire Naval Complex passed through Facility 69. During this period G-ram radioactive materials were temporarily stored at the facility.

Facility 69 appears on the 1943-1962 maps. The facility was originally constructed as an acetylene plant in 1942. The facility was used as a central receiving and shipping warehouse beginning in 1955. Most of the materials, parts, and machinery purchased for the repair and maintenance of ships, submarines, vehicles, and equipment for the entire Naval Complex passed through Facility 69. Prior to expansion of Facility 69 the area had a paint shop (Former Facility 1202) and galvanizing plant (Former Facility 1176). Parkerizing activities were also conducted in the former paint shop. Parkerizing is a surface coating process in which metal components are treated with a dilute phosphate solution to form insoluble crystalline phosphate corrosion resistant surface finishes. The galvanizing and painting operations were conducted from the 1940s to 1985.

According to the 1939 aerial map, this area was graded marshland before construction of the Naval Facilities. The 1909 Map of Charleston shows this area as a marshland.

The facility is located at 1145 Pierside Street west of Dry Docks No. 3 and 4.

Environmental Condition of Property

Major Findings

- AOCs 616 and 617, located on the north side of the facility, are associated with former operations at this facility . A CMS is currently being prepared for possible soil removal or groundwater remediation. (Category 5)

- Diesel, propane gasoline, gear oil, hydraulic oil, and engine oil for the forklifts were observed during the VSI/PSI. A flammable cabinet with water based paint was also located in the facility (Category 2).
- Oily rags, waste oil, and oily absorbent are generated in small quantities at the facility. Waste removal is contracted out (Category 3).
- Previous records indicate a 3,000 gallon UST was located at the facility. The 1995 EBS stated the UST was present. No closure documentation or physical evidence of a UST was identified during the 2001 VSI/PSI and may be abandoned in place (Category 2).
- One dual-walled 500-gallon steel AST containing diesel and one-500-gallon equivalent propane AST were observed during the 2002 VSI/PSI. Observations during the 2002 survey did not indicate stains or stressed vegetation around the AST. Therefore, no release to the environment is assumed to be associated with the AST (Category 2).

Property Categorization Data Gaps

No data gaps impacting categorization of this property's environmental condition were identified.

Categorization

Based on the results of the EBS, the property has been assigned an overall DoD Environmental Condition Category 5.

Property Findings

Hazardous Substances and Petroleum, Oil, and Lubricants (POLs)

Diesel, propane gasoline, gear oil, hydraulic oil, and engine oil for the forklifts were observed during the VSI/PSI. A flammable cabinet with water based paint was also located in the facility.

Hazardous and Non-hazardous Waste Satellite Accumulation Areas (SAAs)

Oily rags, waste oil, and oily absorbent are generated in small quantities at the facility. Waste removal is contracted out.

Installation Restoration Program (IRP) Sites

There are no IRP sites associated with this facility.

Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)

AOCs 616 and 617, located on the north side of the facility, are associated with former operations at this facility . A CMS is currently being prepared for possible soil removal or groundwater remediation.

Oil/Water Separators (OWSs)

Base plan maps and available facility files were reviewed and there are no indications of any OWSs currently or formerly located at this facility. None were observed during the VSI/PSI.

Ordnance and Explosives

The Charleston Naval Complex included specific ordnance storage and handling areas. This facility was not part of the designated areas, therefore, the presence of ordnance at this facility is unlikely.

Underground and Aboveground Storage Tanks (USTs and ASTs)

Previous records indicate a 3,000-gallon UST was located at the facility. The 1995 EBS stated the UST was present. No closure documentation or physical evidence of a UST was identified during the 2001 VSI/PSI.

A dual-walled 200-gallon steel AST containing diesel and one-500-gallon equivalent propane AST were observed during the 2002 VSI/PSI. Observations during the 2002 survey did not indicate stains or stressed vegetation around the AST.

Asbestos-Containing Materials (ACMs)

According to Asbestos Inventory Assessment and Survey conducted by Westinghouse in 1990, suspect asbestos-containing materials were present in non-friable floor and ceiling tiles and wall board in the administrative area at this facility.

Lead-Based Paint (LBP)

All facilities constructed prior to 1981 are likely to have been treated with lead-containing paint. At the time of the VSI/PSI, the painted surfaces at this facility were chipped and peeling.

Polychlorinated Biphenyls (PCBs)

There are two transformers on the northside of the facility with green stickers indicating PCB compliance.

Radon

Radon survey results performed at the facility indicated levels of 0.9 and 1.0pCi/l in the warehouse outside and receiving office respectively. Large roll-up doors designed for allowing large machines or vehicles to enter a facility are found at this facility. These doors are routinely raised and lowered during normal operations. Because these doors allow for natural ventilation, radon gas accumulation is not an issue at this site.

Air Permits and Air Emissions

Based on inquiries and observations, there are no potential sources of air emissions present at this facility.

Floodplain

Based on a recent topographic map (Davis & Floyd, 1998), Facility 69/69A is located above the 12-foot NGVD contours elevation at the Naval Complex, and therefore, is above the 100-year floodplain elevation.

Historic Property

This facility is less than 50 years old and, therefore, does not qualify for consideration as a historic structure under the National Register of Historic Places.

Industrial Waste Collection System (IWCS)

No wastewater is discharged from this facility.

Sanitary Sewer Systems (Wastewater)

Wastewater and sanitary waste from this facility are discharged to the North Charleston Sewer District sanitary sewer system (Reference Drawings H410-234 through 247, Sewage Collection System).

Septic Tanks

No known septic system is now or has been associated with this facility.

Threatened and Endangered Species

An endangered plant survey completed in 1993 (by Richard D. Porcher, The Citadel) determined that there were no endangered species. However, the Sea Purslane has been identified as a confirmed resident of the Naval Base and species of concern by the South Carolina Wildlife and Marine Resources Department. The Osprey and Least Tern have been identified as confirmed residents of the Naval Base. The Osprey is recognized as a species of concern and the Least Tern is recognized as a threatened species by the South Carolina Wildlife and Marine Resources Department.

Wetlands

According to the 1988 U.S. Fish and Wildlife Service National Wetlands maps, the U.S. Army Corps of Engineers 1988 Wetland Delineation Survey of Charleston Naval Base, and visual observations, no wetlands were observed or appear to be currently associated with this facility.

References:

U.S. Department of the Interior, Fish and Wildlife Service, National Wetland Inventory Maps–5050 III SW and 5049 IV NW).

Drawing H606-268, Map of Charleston Naval Shipyard Naval Station and Contiguous Activities Extended and Planned–as Modified by the U.S. Army Corps of Engineers, Charleston District, February 2, 1988.

VISUAL SITE INSPECTION AND PHYSICAL SITE INSPECTION(VSI/PSI) FORM

GENERAL INFORMATION

Facility Number 69/69A — **1145 Pierside Street** — **Charleston Naval Complex**

Date Inspected	8/23/02		
Type of Building	Receiving and Shipping Transit Warehouse	**Area (Sq. Ft.)**	82,533
Type of Construction	Concrete, brick, and galvanized steel	**Year of Construction**	1942/1985

Points of Contact

Name	Title	Years Associated with Building	Shop Name	Telephone Number
Jimmy Kinny	Supervisor	5	Trans-Hold, Inc.	843-747-0553

Description of Facility

Description of Facility (Construction and Use)

- Facility 69 consists of a brick and concrete structure built in 1942. In 1985 an addition of a steel framed structure with galvanized siding and roof was added to the facility. The facility is a shipping and receiving warehouse.
- Length of time of current operations – 5 years.
- Refer to **Figure 1**.

Permitted Operations (Air and Radioactive Materials)

- No permitted operations were identified for this facility, and none were observed during the VSI/PSI.

PHYSICAL SETTING

Current Uses of the Property

Are any current uses likely to involve treatment, storage, disposal, or generation of hazardous substances or petroleum products? _X_ *Yes* ___ *No*

Report current uses based on observation, interviews, and records review.

Facility 69 is used as a shipping and receiving warehouse. Trans-Hold, Inc. occupies the entire facility. Trans-Hold, Inc. handle non-hazardous, dry good products and sports drink. Approximately fifteen semi-tractor trailers loaded with tobacco are parked on the concrete slab on the west side of the facility. One semi-tractor trailer located in this area contains pesticides. The pesticides are periodically applied around the trailers by a licensed contractor. Fork lifts include diesel, propane, and battery powered units. Minor maintenance and repairs for the forklifts is performed on the premises. Major repairs, engine overhauls, and battery repairs are performed off-site.

Past Uses of the Property

Were any past uses likely to have involved treatment, storage, disposal, or generation of hazardous substances or petroleum? _X_ *Yes* ___ *No*

Report all past uses based on observation, interviews, and records review.

From 1985 to 1995, Facility 69 was the central shipping and receiving warehouse for the CNC. Most of the materials, parts, and machinery purchased for the repair and maintenance of ships, submarines, vehicles, and equipment for the entire Naval Complex passed through Facility 69.During this period G-ram radioactive materials were temporarily stored at the facility.

Facility 69 appears on the 1943-1962 maps. The facility was originally constructed as an acetylene plant in 1942. The facility was used as a central receiving and shipping warehouse beginning in 1955. Most of the materials, parts, and machinery purchased for the repair and maintenance of ships, submarines, vehicles, and equipment for the entire Naval Complex passed through Facility 69. Prior to expansion of Facility 69 the area had a paint shop (Former Facility 1202) and galvanizing plant (Former Facility 1176). Parkerizing activities were also conducted in the former paint shop. Parkerizing is a surface coating process in which metal components are treated with a dilute phosphate solution to form insoluble crystalline phosphate corrosion resistant surface finishes. The galvanizing and painting operations were conducted from the 1940s to 1985.

According to the 1939 aerial map, this area was graded marshland before construction of the Naval Facilities. The 1909 Map of Charleston shows this area as a marshland.

Current and Past Uses of Adjoining Properties

Report all past and present uses of adjoining properties within one-quarter mile based on observations, interviews and record review. Report only information on activities likely to cause a recognized environmental impact.

Current or past adjacent facilities include:

- North– Facility 1829, Lumber Storage
- South– Facility 1824, Permitted Hazardous Waste Storage Facility
- East– Dry Docks 3 and 4
- West– Asphalt paving and Hobson Avenue

Roads

Describe all thoroughfares adjoining the property and any roads, streets, and parking lots adjacent to the property.

Facility 69 is accessible from Pierside Street on the east and Supply Street on the north. Hobson Avenue is west of the facility. Kilo Street is on the south side of the facility.

PROPERTY FINDINGS

Air Emissions Sources

Describe all air emissions sources.

Based on inquiries and observations. there are no potential sources of air emissions at this facility.

Shallow Groundwater

Describe condition of shallow groundwater.

Additional investigations are currently underway in Zone F to assess the existence and extent of any shallow groundwater contamination beneath this facility.

Hazardous and Petroleum, Oil, and Lubricant (POL) Substances

Describe uses, waste generation, and storage within facility.

Hazardous and POL Products

Diesel, propane, gasoline, gear oil, hydraulic oil, and engine oil for the forklifts were observed during the VSI/PSI. A flammable cabinet with water based paint was also located in the facility. Pesticides were stored in a locked semi-tractor trailer on the west side of the facility. Pesticide is only applied around semi-tractor trailers containing tobacco located on a concrete slab on the west side of the facility. The pesticide contains hydrogen phosphide.

Hazardous and POL Wastes

Oily rags, waste oil, and oily absorbent are generated in small quantities at the facility. Waste removal is contracted out.

Spill Related Information

Describe the occurrence of spills associated with facility.

There have been no reported spills in the last five years. Prior spill reports include:

- A 1980 memorandum stated several ounces of copper solution were spilled on the concrete floor of the warehouse.
- A leaking rectifier was tested in 1986 and found to contain 313 ppm of PCBs in the released oil. The spill was remediated.
- One 5-gallon bucket of ammonium hydroxide spilled in 1989. The spill was remediated.
- Three 5-gallon cans of two part epoxy were spilled in1987. The spill was remediated.

Installation Restoration Program (IRP) Sites

Describe IRP sites located at the facility.

There are no IRP sites associated with this facility.

Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)

Describe SWMUs located at the facility.

AOCs 616 and 617, located on the north side of the facility, are associated with former operations at this facility. A CMS is currently being prepared for possible soil removal or groundwater remediation.

Storage Tanks and Related Systems

Describe all underground and aboveground tanks, vent pipes, fuel pipes, stored material refueling and loading and unloading areas, and capacity.

Underground Storage Tanks (USTs)

Previous records indicate a 3,000 gallon UST was located at the facility. The 1995 EBS stated the UST was present. No closure documentation or physical evidence of a UST was identified during the 2002 VSI/PSI.

Aboveground Storage Tanks (ASTs)

A dual-walled 200-gallon steel AST containing diesel and one-500-gallon equivalent propane AST were observed during the 2002 VSI/PSI. Observations during the 2002 survey did not indicate stains or stressed vegetation around the AST. Therefore, no release to the environment is associated with the ASTs.

Industrial Waste Discharges

Describe the industrial wastewater collection system for the facility.

No industrial wastewater is generated or discharged by this facility.

Drains and Sumps

Describe the occurrences of drains and sumps at the facility.

Based on inquiries and observations, no sumps are known to be present or to have been present on the property in the past. Floor drains near the battery charging station, in the mechanical room, and in the restrooms are connected to the sanitary sewer system.

Sanitary Sewer and Disposal Systems

Describe the occurrences of sewer and disposal systems at the facility.

Wastewater and sanitary wastes from this facility are discharged to the North Charleston Sewer District (reference Drawings H410-234 through 247, Sewage Collection System).

Surface/Stormwater Systems

Describe the occurrences of surface/stormwater systems at the facility.

Storm water in the area generally occurs as sheet flow radially from the structure Storm grates are located on the north, east and south sides. The storm grates discharge through Outfall Number 38. (Ref Public Works Drawings No. H409-70 through 84).

Silver Recovery Units

Describe the occurrences of silver recovery units at the facility.

This category is not applicable to this type of facility.

Oil/Water Separators (OWSs)

Describe the occurrences of oil/water separators at the facility.

Base plan maps and available facility files were reviewed and there are no indications of any OWSs currently or formerly located at this facility. None were observed during the VSI/PSI.

Washracks

Describe the occurrences of washracks at the facility.

Base plan maps and available facility files were reviewed and there were no indications of any washracks currently or formerly located at this facility. None were observed during the VSI/PSI.

Septic Tanks

Describe the occurrences of septic tanks at the facility.

Interviews with Public Works personnel indicated that, with few exceptions, all facilities on the base are currently connected directly to the North Charleston Sewer District sanitary sewer system. No known septic system is now or has been associated with this facility.

Grease Traps

Describe the occurrences of grease traps at the facility.

This category is not applicable to this type of facility and is associated with food preparation facilities.

PROPERTY DISCLOSURE FACTORS

Asbestos-Containing Material (ACM)

Describe any occurrences of asbestos containing materials at the facility.

According to Asbestos Inventory Assessment and Survey conducted by Westinghouse in 1990, suspect asbestos-containing materials were present in non-friable floor and ceiling tiles and wall board in the administrative area at this facility.

Deicing Agents

Describe any occurrences and uses of deicing agents at the facility.

This category is not applicable to this type of facility.

Lead-Based Paint (LBP)

Describe any occurrences of Lead Based Paint at the facility.

All facilities constructed prior to 1981 are likely to have been treated with lead-containing paint. At the time of the VSI/PSI, the painted surfaces at this facility were chipped and peeling.

Mercury

Describe any occurrences of mercury at the facility.

A Mercury Control Program was in place at the Charleston Naval Complex, under the direction of the Director of Occupational Safety and Health (Code 106). Certifications, periodic inspections, and annual inventories were required. This facility was not under this program because it did not store or use mercury.

Medical/Biohazardous Waste

Describe any occurrences of medical/biohazardous waste at the facility.

This category is not applicable to this type of facility.

Ordnance and Explosives

Describe any occurrences of ordnance or explosives at the facility.

The Charleston Naval Complex included specific ordnance storage and handling areas. This facility was not part of the designated areas, therefore, the presence of ordnance at this facility is unlikely.

Potable Water Quality and Air Quality

Describe any occurrences of potable water and/or air quality issues at the facility.

Potable water for this facility was supplied by the Charleston Commission of Public Works. According to lead-in-drinking-water cooler test results, lead content was found between 0.0043 and 0.009 ppm. Results were below EPA limits and no action was taken.

Polychlorinated Biphenyls (PCBs)

Describe any occurrences of polychlorinated biphenyls at the facility.

Based on inquiries and observations, no electrical or hydraulic equipment in or around the facility contains PCBs.

Transformers

Transformers at the CNC have been transferred to SCE&G. SCE&G personnel interviewed confirmed that all remaining transformers on the CNC have been sampled as a result of the transfer, and all but two are PCB compliant. The two non-compliant transformers are located at Facility 85 and are not associated with this facility. There are two transformers on the northside of the facility with green stickers indicating PCB-compliance.

Capacitors

This category is not applicable to this type of facility.

Hydraulic Units

This category is not applicable to this type of facility.

Light Ballast/Miscellaneous

None noted.

Pesticides/Herbicides

Describe any occurrences of pesticides/herbicides at the facility.

Since base closure in 1995, routine herbicide use at this facility has been discontinued. Pesticides are used on the concrete slab located on the west side of the facility. The pesticide is applied by a licensed contractor around 15 to 20 semi-tractor trailers containing tobacco that are temporarily stored on the slab.

Radiological Substances

Describe any occurrences of radiological substances at the facility.

Facility 1267 was under stringent controls and requirements of the Naval Nuclear Propulsion Program (NNPP) because it was first used for storage of test equipment with radiological sources. This facility was unconditionally released from radiological controls before the shipyard was decommissioned, and the clearance survey was reviewed during closure.

Radon

Describe any occurrences of radon at the facility.

Radon survey results performed at the facility indicated levels of 0.9 and 1.0pCi/l in the warehouse outside and receiving office respectively. Large roll-up doors designed for allowing large machines or vehicles to enter a facility are found at this facility. These doors are routinely raised and lowered during normal operations. Because these doors allow for natural ventilation, radon gas accumulation is not an issue at this site.

Other Tanks (Nonhazardous and Non-POL)

Describe any aboveground or underground tanks at the facility that are not considered to contain hazardous materials or POLs.

Based on inquires and observations during the VSI/PSI, there are no other tanks located at this facility.

OTHER PROPERTY DISCLOSURES

Dry Wells

Describe all wells that are not sources of water of known mineral extraction and are used or suspected to be used for disposal of liquid wastes.

Based on inquiries and observations, no wells are known to be present or to have been present on the property or on adjoining property.

Electrical Supply

Describe main electrical outlets and locations.

This facility is supplied with electrical service via underground lines that enter the facility on the east side.

Heating/Cooling System

Describe the means of heating and cooling of the facility (fuel source).

The existing air conditioning system at this facility consists of window-type air conditioning units mounted in window openings or through-the-wall applications for the offices only. The warehouse is not air conditioned. There is no heating in this facility.

Foundation of Building

Describe foundation type and locate areas of subsidence.

The facility foundation consists of a concrete slab on pilings.

Odors

Report any strong, pungent, or noxious odors. If possible, indicate the sources.

With the exception of the intermittent odor of the nearby paper mill, no other odors were detected.

Pits, Ponds, and Lagoons

Describe all pits, ponds, and lagoons on the property, especially if they are or were used in conjunction with waste disposal or waste treatment. Also, describe pits, ponds, or lagoons on adjoining properties.

There are no pits, ponds, or lagoons located at this facility.

Pools of Liquid

Report all standing surface waters. Describe all pools or low areas containing liquids likely to be hazardous substances or petroleum products.

Storm water was observed ponded on the southwest corner of the facility within the paved storage area.

Stained Soil

Describe any significant areas of stained soil found on the property. Note on plot plans.

Soil staining was not observed during this survey since the area surrounding the facility is paved.

Stains

Describe all significant stains or etchings on floors, walls, and ceilings.

Stains were observed on the floor and are typical where historic or current operations involving the use of hazardous or POL products has occurred, such as the industrial facilities at the CNC. The stains observed at this facility did not extend off the floor to the soil outside the facility, to a floor drain, or to cracks in the floor, and did not constitute a potential release to the environment.

Stressed Vegetation

Describe any areas of stressed vegetation (from a cause other than insufficient water).

No vegetation exists on the property surrounding this facility, because there is no exposed soil.

Non-Stormwater Discharges

Describe any wastewater or other liquids, other than stormwater, which discharge into a ditch or stream on or adjacent to the property.

No ditches or streams were on or adjacent to this property.

Wetlands

Describe location and approximate size.

According to the 1988 U.S. Fish and Wildlife Service National Wetlands maps, the U.S. Army Corps of Engineers 1988 Wetland Delineation Survey of Charleston Naval Base, and visual observations, no wetlands were observed or appear to be associated with this facility.

References:

U.S. Department of the Interior, Fish and Wildlife Service. National Wetland Inventory Maps–5050 III SW and 5049 IV NW).

Drawing H606-268. Map of Charleston Naval Shipyard Naval Station and Contiguous Activities Extended and Planned–as Modified by the U.S. Army Corps of Engineers, Charleston District, February 2, 1988.

NATURAL AND CULTURAL RESOURCES

Cultural Resources

Describe any cultural resources.

Although a portion of this facility is more than 50 years old and is eligible for listing on the National Register of Historic Places, it has been classified as non-historic.

Biological Resources

Describe any biological resources that may affect the facility.

An endangered plant survey completed in 1993 (by Richard D. Porcher, The Citadel) determined that there were no endangered species. However, the sea purslane has been identified as a confirmed resident of the Naval Base and is a listed species of concern by the South Carolina Wildlife and Marine Resources Department.

The osprey and least tern have been identified as confirmed residents of the Naval Base. The osprey is recognized as a species of concern and the least tern is recognized as a threatened and endangered (T&E) species by the South Carolina Wildlife and Marine Resources Department and the U.S. Fish and Wildlife Service.

Unusual Geologic Resources and Conditions

Describe any geologic condition that may affect the facility.

An earthquake struck the Charleston area in 1886 that affected a 50-kilometer area and was felt as far as 1,000 kilometers from the epicenter. Although the Charleston area is not considered an earthquake-prone area based on the frequency of historic earthquakes, studies by the Earthquake Branch of the U.S. Geological Survey, indicate that the region is undergoing intra-plate motion. The Atlantic oceanic plate that is currently sliding westward beneath the earth's crust that includes the Charleston region, and is being recorded as micro-seismic events. Release of lithostatic pressure during intra-plate motion has, on occasion, manifested itself at the surface as an earthquake.

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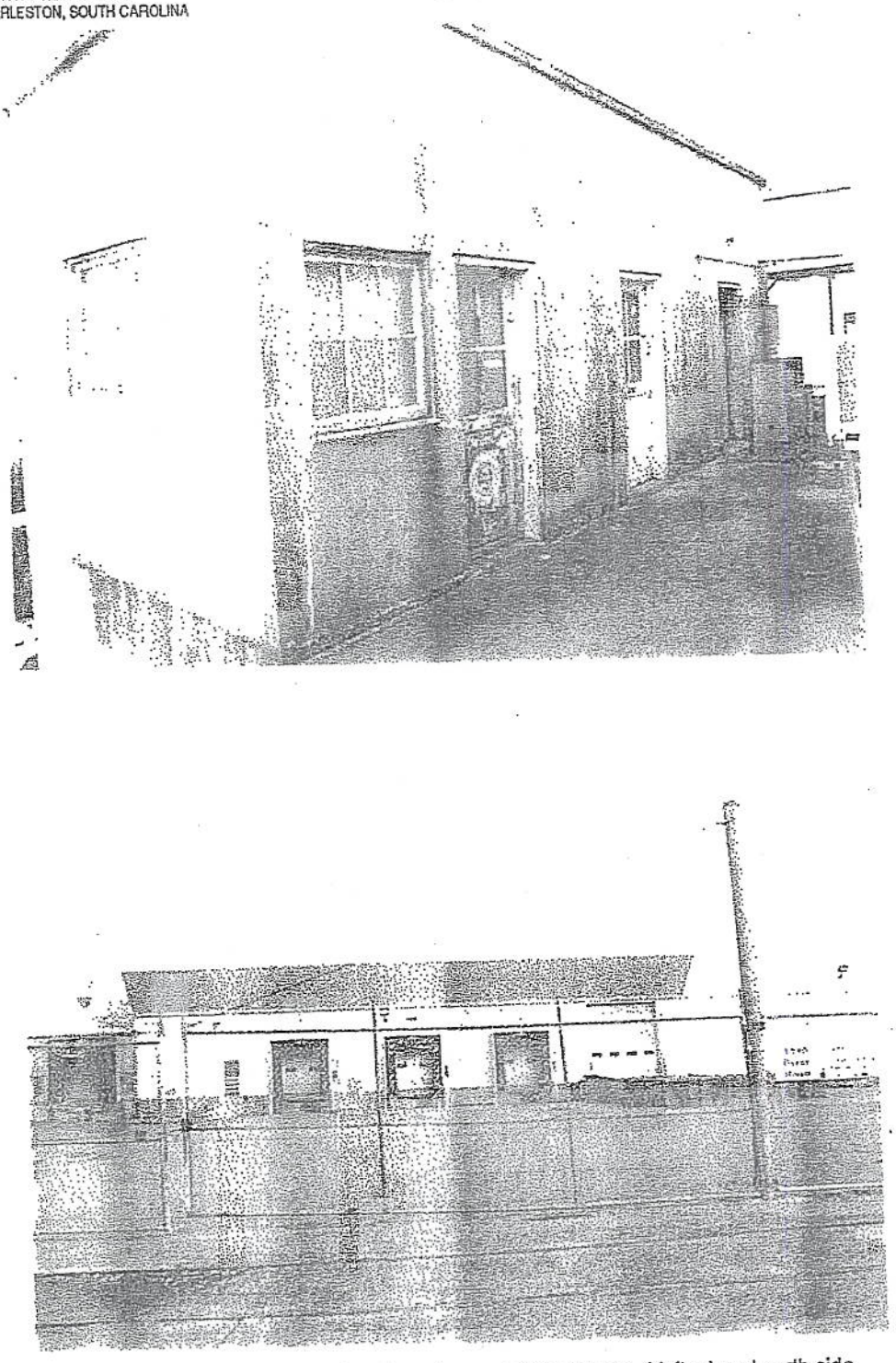

Photo 1 and Photo 1A. View of southeast corner of Facility No. 69 (top) and north side of Facility 69A (bottom) constructed in 1942. Both facilities are storehouses for receiving and shipping. The physical address is 1145 Pierside Street.

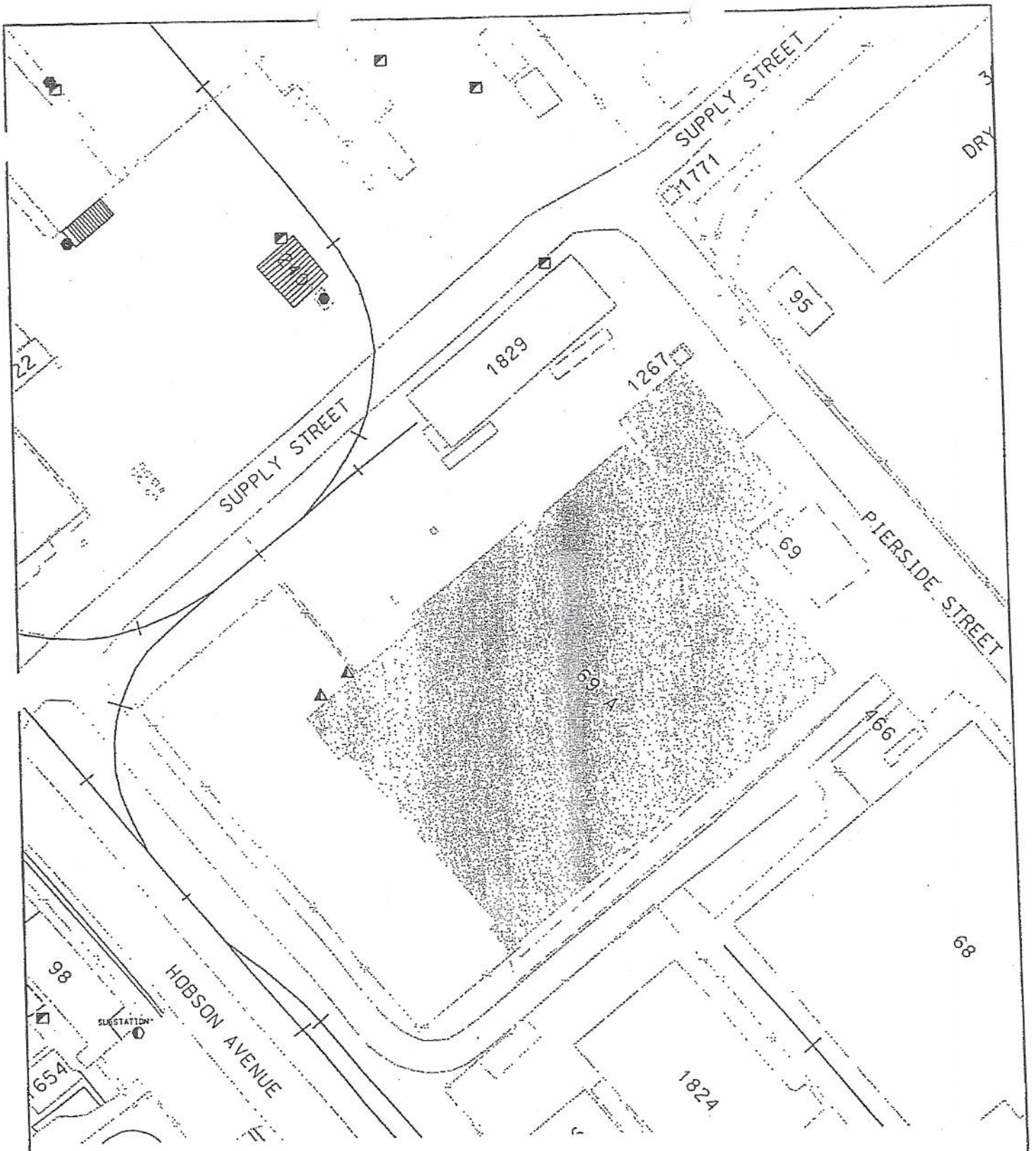

FIGURE 1
Building 69/69A
Environmental Baseline Survey
for Transfer Phase IV Parcels
Charleston Naval Complex
North Charleston, South Carolina

SAN//CAD/CHARLESTON/158814/58814-F69-69A.DLV
17-SEPT-2002

APPENDIX L

Project Business Proforma and Dedicated Facility Models

Clemson University Wind Turbine Test Facility Proforma
Case 1: 'Shared' Facility

Test Fee Surcharge 12.0%
CPI 2.0%
Facility Availability 50 weeks (Assumes 2 week annual maintenance outage)

	Year 1	Year2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Facility Utilization Assumptions	0%	0%	0%	50%	75%	75%	75%	75%	75%	75%	75%	75%
Staffing												
Principal Investigator /Advisor	$37,750	$37,750	$37,750	$37,750	$37,750							
CURI Advisor	$12,015	$12,015	$12,015	$12,015	$12,015							
PSA VP Oversight	$24,273	$24,273	$24,273	$24,273	$24,273							
Facility Director	$137,000	$137,000	$137,000	$137,000	$137,000	$139,740	$139,740	$142,535	$142,535	$145,385	$145,385	$148,293
Admin Specialist	$9,999	$9,999	$9,999	$9,999	$9,999	$10,199	$10,403	$10,611	$10,823	$11,040	$11,260	$11,486
Project Controller	$73,225	$73,225	$73,225	$36,612	$36,612							
Fiscal Technician	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729
Business Development	$21,200	$21,200	$21,200	$21,200	$21,200	$21,624	$21,624	$22,056	$22,056	$22,498	$22,498	$22,948
Technical Sales		$30,000	$60,000	$60,000	$60,000	$61,200	$61,200	$62,424	$62,424	$63,672	$63,672	$64,946
Test Engineer I		$87,500	$87,500	$87,500	$87,500	$89,250	$89,250	$91,035	$91,035	$92,856	$92,856	$94,713
Test Engineer II		$87,500	$87,500	$87,500	$87,500	$89,250	$89,250	$91,035	$91,035	$92,856	$92,856	$94,713
Operators - II			$65,000	$65,000	$65,000	$66,300	$66,300	$67,626	$67,626	$68,979	$68,979	$70,358
Operators - I			$65,000	$65,000	$65,000	$66,300	$66,300	$67,626	$67,626	$68,979	$68,979	$70,358
Systems Engineer			$75,000	$75,000	$75,000	$76,500	$76,500	$78,030	$78,030	$79,591	$79,591	$81,182
Maintenance Tech 1			$70,000	$70,000	$70,000	$71,400	$71,400	$72,828	$72,828	$74,285	$74,285	$75,770
Maintenance Tech 2			$70,000	$70,000	$70,000	$71,400	$71,400	$72,828	$72,828	$74,285	$74,285	$75,770
Project Manager	$131,000	$131,000	$131,000									
Safety Manager	$65,000	$65,000	$65,000									
Summer Interns (2 Grad - 2 Undergrad)			$20,000	$20,000	$20,000	$20,400	$20,400	$20,808	$20,808	$21,224	$21,224	$21,649
Sub-Total	$529,191	$734,191	$1,129,191	$896,578	$896,578	$801,292	$801,496	$817,171	$817,384	$833,377	$833,597	$849,915
Fringe & Benefits	$179,249	$249,831	$379,963	$299,875	$299,875	$269,902	$269,972	$275,249	$275,322	$280,707	$280,783	$286,276
Total Staffing	$708,440	$984,022	$1,509,154	$1,196,453	$1,196,453	$1,071,194	$1,071,468	$1,092,420	$1,092,706	$1,114,084	$1,114,380	$1,136,191
Travel	$30,500	$45,200	$39,200	$15,000	$15,300	$15,606	$15,918	$16,236	$16,561	$16,892	$17,230	$17,575
Admin Supplies	$15,000	$20,000	$10,000	$10,000	$10,200	$10,404	$10,612	$10,824	$11,041	$11,262	$11,487	$11,717
Client Consumables				$20,000	$20,400	$20,808	$21,224	$21,649	$22,082	$22,523	$22,974	$23,433
Marketing and Sales				$60,000	$61,200	$62,424	$63,672	$64,946	$66,245	$67,570	$68,921	$70,300
AAB and IAB Annual Mtg		$25,000	$25,000	$25,000	$25,000	$25,500	$26,010	$26,530	$27,061	$27,602	$28,154	$28,717
Utilities			$90,000	$180,000	$183,600	$187,272	$191,017	$194,838	$198,735	$202,709	$206,763	$210,899
Insurance and Liability	$25,000	$50,000	$75,000	$100,000	$102,000	$104,040	$106,121	$108,243	$110,408	$112,616	$114,869	$117,166
Maintenance Supplies				$75,000	$100,000	$102,000	$104,040	$106,121	$108,243	$110,408	$112,616	$114,869
Major Maint Cap or Cap Improvments (See **)						$223,743	$222,999	$222,999	$222,999	$222,999	$222,999	$222,999
Sub-total	$70,500	$140,200	$239,200	$485,000	$517,700	$751,797	$761,614	$772,386	$783,374	$794,582	$806,013	$817,673
Capital												
Bldg 69 Modifications												
Engineering	$900,000	$100,000										
Equipment	$400,000	$2,400,000										
Construction	$3,500,000	$9,256,000										
Owner Furnished Equipment		$270,000										
Contingency	$480,000	$1,221,000										
Sub-total	$5,280,000	$13,247,000										
Test Rigs												
Test Rig #1	$6,407,982	$2,746,278										
Blade Force Simulator	$9,068,924	$3,886,681										
Support Structures	$1,194,709	$512,017										
2nd 7.5MW Motor for Test Rig #1			$4,300,000									
Test Rig #2	$5,756,323	$2,466,996										
Climatic Chamber	$1,411,928	$605,112										
Sound Separation System	$380,135	$162,915										
Transport		$70,000	$40,000									

Clemson University Wind Turbine Test Facility
Case 1: 'Shared' Facility

Test Fee Surcharge
CPI
Facility Availability

Facility Utilization Assumptions	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
	75%	75%	75%	75%	75%	75%	75%	75%
Staffing								
Principal Investigator /Advisor								
CURI Advisor								
PSA VP Oversight								
Facility Director	$148,293	$151,259	$151,259	$151,259	$151,259	$151,259	$151,259	$151,259
Admin Specialist	$11,715	$11,950	$12,189	$12,432	$12,681	$12,935	$13,193	$13,457
Project Controller								
Fiscal Technician	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729	$17,729
Business Development	$22,948	$23,407	$23,407	$23,407	$23,407	$23,407	$23,407	$23,407
Technical Sales	$64,946	$66,245	$66,245	$66,245	$66,245	$66,245	$66,245	$66,245
Test Engineer I	$94,713	$96,607	$96,607	$96,607	$96,607	$96,607	$96,607	$96,607
Test Engineer II	$94,713	$96,607	$96,607	$96,607	$96,607	$96,607	$96,607	$96,607
Operators - II	$70,358	$71,765	$71,765	$71,765	$71,765	$71,765	$71,765	$71,765
Operators - I	$70,358	$71,765	$71,765	$71,765	$71,765	$71,765	$71,765	$71,765
Systems Engineer	$81,182	$82,806	$82,806	$82,806	$82,806	$82,806	$82,806	$82,806
Maintenance Tech 1	$75,770	$77,286	$77,286	$77,286	$77,286	$77,286	$77,286	$77,286
Maintenance Tech 2	$75,770	$77,286	$77,286	$77,286	$77,286	$77,286	$77,286	$77,286
Project Manager								
Safety Manager								
Summer Interns (2 Grad - 2 Undergrad)	$21,649	$22,082	$22,523	$22,974	$23,433	$23,902	$24,380	$24,867
Sub-Total	$850,144	$866,793	$867,473	$868,168	$868,876	$869,598	$870,335	$871,086
Fringe & Benefits	$286,355	$291,960	$292,065	$292,172	$292,281	$292,392	$292,506	$292,621
Total Staffing	$1,136,499	$1,158,753	$1,159,538	$1,160,340	$1,161,157	$1,161,990	$1,162,841	$1,163,707
Travel	$17,926	$18,285	$18,651	$19,024	$19,404	$19,792	$20,188	$20,592
Admin Supplies	$11,951	$12,190	$12,434	$12,682	$12,936	$13,195	$13,459	$13,728
Client Consumables	$23,902	$24,380	$24,867	$25,365	$25,872	$26,390	$26,917	$27,456
Marketing and Sales	$71,706	$73,140	$74,602	$76,095	$77,616	$79,169	$80,752	$82,367
AAB and IAB Annual Mtg	$29,291	$29,877	$30,475	$31,084	$31,706	$32,340	$32,987	$33,647
Utilities	$215,117	$219,419	$223,807	$228,284	$232,849	$237,506	$242,256	$247,101
Insurance and Liability	$119,509	$121,899	$124,337	$126,824	$129,361	$131,948	$134,587	$137,279
Maintenance Supplies	$117,166	$119,509	$121,899	$124,337	$126,824	$129,361	$131,948	$134,587
Major Maint Cap or Cap Improvments (See **)	$222,999	$222,999	$222,999	$222,999	$222,999	$222,999	$222,999	$222,999
Sub-total	$829,567	$841,698	$854,072	$866,694	$879,568	$892,699	$906,093	$919,755
Capital								
Bldg 69 Modifications								
Engineering								
Equipment								
Construction								
Owner Furnished Equipment								
Contingency								
Sub-total								
Test Rigs								
Test Rig #1								
Blade Force Simulator								
Support Structures								
2nd 7.5MW Motoer for Test Rig #1								
Test Rig #2								
Climatic Chamber								
Sound Separation System								
Transport								

	Year 1	Year2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Test Bed Certification			$400,000		$0							
Sub-total	$24,220,001	$10,449,999	$4,740,000									
Data Acquisition System	$586,687	$1,825,063	$397,000									
Facility Electrical Infrastructure	$1,045,722	$1,954,056										
Sub-total	$1,632,409	$3,779,119	$397,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Total	$31,132,410	$27,476,118	$5,137,000	$0	$0	$0	$0	$0	$0	$2,500,000	$0	$0
Expense Total	**$31,911,350**	**$28,600,340**	**$6,885,354**	**$1,681,453**	**$1,714,153**	**$1,822,991**	**$1,833,082**	**$1,864,807**	**$1,876,080**	**$4,408,665**	**$1,920,394**	**$1,953,864**
Revenue Generation												
US DOE Grant Award ($45M)	$29,973,882	$14,229,118	$797,000	$0	$0							
State of South Carolina Funds ($10M)	$1,053,528	$7,142,000	$1,235,000		$569,472							
Other State Funds ($6M)		$3,000,000	$3,000,000									
Clemson University ($6.205M)	$778,940	$1,124,222	$1,748,354	$1,576,453	$977,031							
Corporate ($3M)		$3,000,000										
Private Donations	$105,000	$105,000	$105,000	$105,000	$105,000							
				$840,727	$1,714,153	$1,822,991	$1,833,082	$1,864,807	$1,876,080	$1,908,665	$1,920,394	$1,953,864
Test Revenue Generation				$100,887	$154,274	$164,069	$164,977	$167,833	$168,847	$396,780	$172,835	$175,848
Test Fee Surcharge												
Test Charge/Week: Test Rig #1				$24,859	$32,884	$34,972	$35,166	$35,774	$35,991	$40,576	$36,841	$37,483
Test Charge/Week: Test Rig #2				$12,429	$16,442	$17,486	$17,583	$17,887	$17,995	$20,288	$18,420	$18,741
Analytical Support Services (CU Laboratories)				$40,000	$80,000	$100,000	$120,000	$150,000	$150,000	$150,000	$150,000	$150,000
Test Fee Surcharge for Analytical Services				$4,800	$9,600	$12,000	$14,400	$18,000	$18,000	$18,000	$18,000	$18,000
Total Revenue	***$31,911,350***	***$28,600,340***	***$6,885,354***	***$2,627,867***	***$3,529,530***	***$1,999,060***	***$2,012,459***	***$2,050,639***	***$2,062,927***	***$2,323,445***	***$2,111,229***	***$2,147,712***
Cash Flow	$0	$0	$0	$946,414	$1,815,377	$176,069	$179,377	$185,833	$186,847	($2,085,220)	$190,835	$193,848
Cash Reserves	$0	$0	$0	$946,414	$2,761,791	$2,937,860	$3,117,237	$3,303,070	$3,489,917	$1,404,697	$1,595,533	$1,789,380

**Major Capital or Capital Improvement Fund was based on 10% of a 20 year depreciation schedule based on installed cost of equipment starting in Year 6 to finance future facility capital maintenance or improvements based on Industry nee

	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Test Bed Certification								
Sub-total								
Data Acquisition System								
Facility Electrical Infrastructure								
Sub-total	$0	$0	$0	$0	$0	$0	$0	$0
Capital Total	$0	$0	$2,500,000	$0	$0	$0	$0	$0
Expense Total	**$1,966,066**	**$2,000,451**	**$4,513,611**	**$2,027,033**	**$2,040,724**	**$2,054,689**	**$2,068,934**	**$2,083,462**
Revenue Generation								
US DOE Grant Award ($45M)								
State of South Carolina Funds ($10M)								
Other State Funds ($6M)								
Clemson University ($6.205M)								
Corporate ($3M)								
Private Donations								
Test Revenue Generation	$1,966,066	$2,000,451	$2,013,611	$2,027,033	$2,040,724	$2,054,689	$2,068,934	$2,083,462
Test Fee Surcharge	$176,946	$180,041	$406,225	$182,433	$183,665	$184,922	$186,204	$187,512
Test Charge/Week: Test Rig #1	$37,717	$38,377	$42,589	$38,887	$39,149	$39,417	$39,690	$39,969
Test Charge/Week: Test Rig #2	$18,859	$19,188	$21,295	$19,443	$19,575	$19,709	$19,845	$19,985
Analytical Support Services (CU Laboratories)	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
Test Fee Surcharge for Analytical Services	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000
Total Revenue	***$2,161,012***	***$2,198,492***	***$2,437,836***	***$2,227,466***	***$2,242,390***	***$2,257,611***	***$2,273,138***	***$2,288,974***
Cash Flow	$194,946	$198,041	($2,075,775)	$200,433	$201,665	$202,922	$204,204	$205,512
Cash Reserves	$1,984,326	$2,182,367	$106,592	$307,025	$508,690	$711,612	$915,816	$1,121,328

**Major Capital or Capital Improvement Fund was based eds and evolving turbine technology.

Case 2: 'Dedicated' HALT Facility with Blade Force Simulator

CPI 2.0%

Facility Availability 50 weeks (Assumes 2 week annual maintenance outage)

Facility Utilization Assumptions		Year 1	Year2	Year 3	Year 4	Year 5	Year 10	Year 15	Year 20
				75%	75%	75%	75%	75%	75%
Staffing	Test Engineer		$87,500	$87,500	$87,500	$87,500	$92,856	$96,607	$96,607
	Operator			$65,000	$65,000	$65,000	$68,979	$71,765	$71,765
	Maintenance Tech			$70,000	$70,000	$70,000	$74,285	$77,286	$77,286
	Sub-Total	$0	$87,500	$222,500	$222,500	$222,500	$236,119	$245,658	$245,658
	Fringe & Benefits	$0	$30,126	$76,607	$76,607	$76,607	$81,296	$84,580	$84,580
	Total Staffing	$0	$117,626	$299,107	$299,107	$299,107	$317,414	$330,238	$330,238
	Insurance and Liability	$25,000	$50,000	$100,000	$102,000	$104,040	$114,869	$126,824	$140,024
	Maintenance Supplies			$75,000	$150,000	$153,000	$168,924	$186,506	$205,918
	Sub-total	$25,000	$50,000	$175,000	$252,000	$257,040	$283,793	$313,330	$345,942
Capital	Test Building Infrastructure	$2,000,000	$2,000,000						
	Test Rig #1	$8,260,000	$3,540,000						
	2nd 7.5 MW Motor for Test Rig #1		$4,300,000						
	Blade Force Simulator	$11,690,000	$5,010,000						
	Climatic Chamber	$1,820,000	$780,000						
	Support Structures	$1,141,000	$559,000						
	Sub-total	$22,911,000	$14,189,000	$0		$0			
	Data Acquisition System	$250,000	$250,000						
	Facility Electrical Infrastructure	$500,000	$500,000						
	Sub-total	$750,000	$750,000	$0	$0	$0	$0	$0	$0
	Capital Total	$23,661,000	$14,939,000	$0	$0	$0	$0	$0	$0
	Depreciation			$1,930,000	$1,930,000	$1,930,000	$1,930,000	$1,930,000	$1,930,000
	Cost of Capital @ 6%	$1,419,660	$2,316,000	$2,200,200	$2,084,400	$1,968,600	$1,389,600	$810,600	$231,600
Expense Total		**$25,105,660**	**$17,422,626**	**$2,674,307**	**$2,635,507**	**$2,524,747**	**$1,990,807**	**$1,454,168**	**$907,780**
	Cost to operate ($/week)			$71,315	$70,280	$67,327	$53,088	$38,778	$24,207

Case 3: 'Dedicated' 7.5 MW HALT Facility without Blade Force Simulator

CPI 2.0%
Facility Availability 50 weeks (Assumes 2 week annual maintenance outage)

		Year 1	Year2	Year 3	Year 4	Year 5	Year 10	Year 15	Year 20
Facility Utilization Assumptions				75%	75%	75%	75%	75%	75%
Staffing	Test Engineer		$87,500	$87,500	$87,500	$87,500	$92,856	$96,607	$96,607
	Operator			$65,000	$65,000	$65,000	$68,979	$71,765	$71,765
	Maintenance Tech			$70,000	$70,000	$70,000	$74,285	$77,286	$77,286
	Sub-Total	$0	$87,500	$222,500	$222,500	$222,500	$236,119	$245,658	$245,658
	Fringe & Benefits	$0	$30,126	$76,607	$76,607	$76,607	$81,296	$84,580	$84,580
	Total Staffing	$0	$117,626	$299,107	$299,107	$299,107	$317,414	$330,238	$330,238
	Insurance and Liability	$25,000	$50,000	$100,000	$102,000	$104,040	$114,869	$126,824	$140,024
	Maintenance Supplies			$75,000	$150,000	$153,000	$168,924	$186,506	$205,918
	Sub-total	$25,000	$50,000	$175,000	$252,000	$257,040	$283,793	$313,330	$345,942
Capital	Test Building Infrastructure	$1,000,000	$1,000,000						
	Test Rig #2	$7,600,000	$3,000,000						
	Climatic Chamber	$1,820,000	$780,000						
	Sub-total	$9,420,000	$3,780,000	$0		$0			
	Data Acquisition System	$150,000	$150,000						
	Facility Electrical Infrastructure	$500,000	$500,000						
	Sub-total	$650,000	$650,000	$0	$0	$0	$0	$0	$0
	Capital Total	$10,070,000	$4,430,000	$0	$0	$0	$0	$0	$0
	Depreciation			$725,000	$725,000	$725,000	$725,000	$725,000	$725,000
	Cost of Capital @ 6%	$604,200	$870,000	$826,500	$783,000	$739,500	$522,000	$304,500	$87,000
Expense Total		**$10,699,200**	**$5,467,626**	**$1,300,607**	**$1,334,107**	**$1,295,647**	**$1,123,207**	**$948,068**	**$763,180**
	Cost to operate ($/week)			$34,683	$35,576	$34,551	$29,952	$25,282	$20,351

Resumes follow for the following key personnel:

1) S. Imtiaz UL Haque (Principal Investigator) Clemson University
2) Joseph V Cordaro – SRNL
3) Jörg Cordes – Renk Labeko Test Systems Corporation
4) Michael J Drews – Clemson University
5) Shawn J Gaffney - EcoEnergy
6) Alan M Godfrey – Clemson University
7) Stephen T Hung – Clemson University
8) John W Kelly – Clemson University
9) Michael D Messman – Clemson University (CUICAR)
10) Nicholas C Rigas – Clemson University
11) George R Trask – Clemson University / Pilgrim Associates
12) Paul J Venhovens – Clemson University (CUICAR)

S. IMTIAZ UL HAQUE, Fellow ASME
Professor and Executive Director
Carroll A. Campbell Jr. Graduate Engineering Center
Department of Mechanical Engineering, Clemson, South Carolina, U. S. A.
CU- International Center for Automotive Research, Greenville, South Carolina, U. S. A.
Office: 864.283.7217 / Email: sih@exchange. clemson.edu

Education and Training:

- Ph.D., Clemson University, 1982, Engineering Mechanics
- MS., Clemson University, 1977, Mechanical Engineering
- B.Sc., University of Engineering and Technology (Pakistan), 1972, Mechanical Engineering

Professional Experience:

Clemson University, Clemson, SC.

- Executive Director, Carroll A. Campbell Graduate Engineering Center, January 1, 2009 – present
- Chair, Department of Mechanical Engineering, July 2002-Dec. 2008
- Professor of Mechanical Engineering (1994-present)
- Associate Professor of Mechanical Engineering (1989-1994)
- Assistant Professor of Mechanical Engineering (1983-88)
- Visiting Assistant Professor of Mechanical Engineering (1982-1983)

Bayerische Motor Werke, Munich, Germany (sabbatical)

- Visiting Research Scientist (1996-1997)

NESPAK Engineering Consultants to the World Bank

- Junior Engineer, (1973-1974)

Pakistan Engineering Company

- Design Engineer, (1972-1973)

Consulting

- Thrall Car Company
- American Steel Foundries
- U. S. Army
- MARTA
- Argus Research Corporation
- Milliken Company
- Association of American Railroads
- Trailer-Railer Corporation
- LTK Associates
- Fairchild-Weston

Select Publications

1. Cui, Kan and I. Haque, "On Configurations of Symbolic Equations of Motion for Hybrid Multi-Body Systems," Intl. Journal of Mechanisms and Machine Theory,Vol.32, No. 6, pp.743-763, 1997.
2. Srivastava, N., Bluoin, Haque, I., and G. Fadel "Performance of a Continuously Variable Transmission in a Medium Duty Vehicle - A Case Study," 8th Annual ARC Conference on Modeling and Simulation of Ground Vehicles, Paper No. 1B-3, May 14-15, Ann Arbor, MI, USA, 2002.
3. Georges Fadel, Vincent Blouin, and Imtiaz Haque,"Continuously Variable Transmission Design for Optimum Vehicle Performance by Analytical Target Cascading," Journal of Global Automotive

Manufacturing and Technology, 2003
4. Srivastava, N., Blouin, V. Y., Haque, I. U., "Using Genetic Algorithms to Identify Initial Operating Conditions for a Transient CVT Model," 2004 IMECHE Congress Paper No. IMECE2004-61999, November 13-19, Anaheim, CA, USA, 2004.
5. M. Gobbi, I. Haque, P.Y. Papalambros, G. Mastinu, "Optimisation and integration of ground vehicle systems" Invited State-of-the-art paper, IAVSD Conference, Milano, Italy 2005. Also published in Vehicle System Dynamics, Vol. 43, No. 6–7, June–July 2005, p. 437–453, (1).
6. Srivastava, N., Haque, I. "A Review on Belt and Chain Continuously Variable Transmissions (CVT), " Mechanism and Machine Theory 2008. [Available online, DOI: 10.1016/ j.mechmachtheory. 2008.06.007]
7. Nilabh Srivastava , Imtiaz U. Haque , "Transient Dynamics of Metal V- belt CVT: Effects of band ·pack slip and friction characteristic", Journal of Mechanism and Machine Theory, 2007 [Available online, DOI:10.1016/j.mechmachtheory.2007.04.005]
8. Srivastava, N., Haque, I., "Transient Dynamics of Metal V-belt CVT: Effects of Pulley Flexibility and Friction Characteristic," ASME Journal of Computational and Nonlinear Dynamics, Paper No. CND-06-1084, Vol.2, Issue 1, pp. 86-97, 2007.[Available online, DOI: 10.1115/1.2389233].
9. Srivastava, N., Haque, I., "Nonlinear Dynamics of a Friction-limited drive: Application to a Chain CVT system," Journal of Sound and Vibration, 2008. [Available online, DOI: 10.1016/ j.jsv. 2008.09.045].
10. M. Grujicic, G. Arakere, W. C. Bell, H. Marvi, H. V. Yalavarthy, B. Pandurangan, I. Haque, and G. M. Fadel, " Reliability-based Design Optimization for Durability of Ground-vehicle Suspension-System Components ," Journal of Materials Engineering and Performance, accepted for publication, April 2009.

Professional Activities:

- Paper and Proposal Reviewer for 19 journals and funding agencies
- Technical Symposium organizer for ASME. Organized numerous symposia.
- Member of the Editorial Board, International Journal of Heavy Vehicle Systems (Current).
- Vice-Chair, ASME Design Division, Vehicle Design Committee (1998- 2005).

Synergistic Activities

- Extensive experience in managing faculty and staff, personnel hiring, fundraising, and project management. Served as Department Chair of Mechanical Engineering for six and a half years. Hired 19 faculty and 12 staff members. The department added four endowed chairs and two professorships with endowment funds totaling over $32M. Also served as co-PI on proposal for a $6M Endowed Chair in Electrical Engineering.
- Co-Leadership role in the setting up of the CUICAR campus, a private-public partnership that has raised over $215M for the project. CUICAR is a unique public –private partnership that brings together leading automotive companies, state government, and a major research university.
- Active participation in oversight of the building programming, building construction, and facility installation of the Carroll A. Campbell Jr. Graduate Engineering Center (CGEC). CGEC is a $50M+ facility that houses full vehicle testing equipment valued over $16M including installation.
- Executive Director for the CGEC. Responsibilities include oversight of the automotive engineering program including education and research, seven staff and one research engineer, leadership in setting research directions for center, fundraising and recruiting of new industry partners, and strategic planning for business development of testing facilities.
- Research and teaching interests lie in dynamics of multi-body systems, vehicle and machine dynamics, and powertrain dynamics. Course development and teaching in powertrain and driveline integration in automotive systems and leadership and project management.

SRNL
SAVANNAH RIVER NATIONAL LABORATORY

Resume'

Name Joseph V. Cordaro

Address Savannah River National Laboratory
Building 723-A, Savannah River Site
Aiken, SC 29808
Telephone (803)725-5020
Fax (803)725-9753
Email joe.cordaro@srnl.doe.gov

Education

1984 Bachelors of Science Degrees in Electrical and Computer Engineering, State University of New York, Buffalo, NY

Experience

1984-1989 Various Engineering Positions, DuPont, Equipment Engineering Department, supporting numerous site customers

1989-2005 Tritium Lead, Westinghouse Savannah River Company, Savannah River Technology Center, Engineered Equipment and Systems, tritium processing and weapons component testing support

2005-2009 Advisory Engineer, Savannah River National Laboratory

Mr. Cordaro is recognized across the DOE complex and internationally in the areas of nuclear instrumentation, process control and high-speed data acquisition and controls systems, particularly as they apply in the development of systems for nuclear weapons component testing. His is the former Chair of the Network of Senior Scientists and Engineers (NSSE) formed by the DOE National Nuclear Security Administration (NNSA) to solve complex wide problems. The NSSE is made up of senior scientists and engineers from each NNSA production site and laboratory. Mr. Cordaro has expertise in instrumentation, high-speed data acquisition, electronics, process control, and calibration particularly as they apply to tritium processing technologies and weapons component testing. He has been a major participant and the design lead for the design and implementation of major tritium related programs at the Savannah River Site including Reservoir Surveillance Operations, Non-Nuclear Reconfiguration, and Life Storage. He has developed new technologies in cryogenic temperature controls, centrifuge off-balance sensing, reservoir leak detection, and automation technologies for leak checking shipping containers. He led the design team at Savannah River for the data acquisition and control systems for high g shock, vibration and linear acceleration systems.

Outside of the tritium arena, he and an analytical chemist have developed an automated controlled potential coulometer for the measurement of plutonium in solution. This system, which utilizes electronic calibrations traceable to NIST, can accurately measure plutonium independent of certified reference material. It is used by the US DOE New Brunswick Laboratory to certify the United States plutonium and neptunium standards. Mr. Cordaro has developed and submitted a patent for an Industrialized Universal Electrometer that can accurately measure current as low as 1 Femto Amp. In the area of high-resolution mass spectrometers, Mr. Cordaro has recently designed improved Faraday Cup amplifiers, extremely high-resolution electric field and magnet field control and data acquisition systems and is

upgrading el ectronics and software fo r Savannah River Site, the Pantex Plant and San dia National Laboratory.

Mr. Cordaro is presently leading a million dollar proj ect to develop ultra sec ure and robust short-range wireless sensors networks for the NNS A nuclear faciliti es. He has partnered with the Natio nal Security Agency to develop a wireless network for the trans mission of classified Secret data. His paper "Wireless for a Nuclear Facility" was selected by ISA for the Charles Basset award for the most outstanding paper in 2007.

Awards

George Westinghouse Signature Awards (1990, 1992)
Westinghouse Presidents Awards (1996, 1998)
DOE Weapons Awards of Excellence (1993, 1994, 1995, 1999, 2006)
Westinghouse Award for Service Excellence (1998)
WSRC Total Quality Achievement Award (1991, 1992, 1993)

Inventions

Inventions and disclosures relevant to this project:
1999 - Centrifuge Unbalance Sensor; patent awarded 2002
2006 - Industrial Universal Electrometer, patent pending
2006 - Nano Proportional Counter, patent pending
2009 - Secure Tracking, Tagging and Location of Assets, patent pending

Publications

1) Electronics Upgrade of High Resolution Mass Spectrometers, WSRC-STI-2007-00658
2) Wireless for a Nuclear Facility, WSRC-STI-2007-00155-S
3) Uncertainty Analysis for Gas Leak Rate Measurements, SRNL-IES-2007-00021, 2007
4) DOE Report DP-1751, 1988, Joseph V. Cordaro and Michael Holland, "An Automated Instrument for Controlled Potential Coulometry"
5) WSRC-RP-96-287, 1996, Joseph V. Cordaro, "Qualification of the NNR Flow Tester"
6) WSRC-MS-90-223, 1990, Joseph V . Cordar o and Susan Collins, "Real Ti me DACS for Functional Testing of Weapon Components"
7) EED8708 10, 1 987, Jo seph V. Cordaro and Mi ke Wood, " QA Validation of t he Automatic Leak Detector"
8) University of South Carolina publication , 1986, Joseph V. Cordaro, "A Neural Optimization Network"
9) WSRC-MS-91-333, 1991, Joseph V. Cordaro and Y. K. Lutz, "Function Test Facility: Data Acquisition and Control"
10) WSRC-MS-9700668, 1997, Joseph V. Cordaro, "Automated Leak Test Systems"

Jörg Cordes
Renk Labeco Test Systems Corp.
156 East Harrison Street
Mooresville, IN 46158

Education and Training:
Mechanical Engineering
(Focused on Engineering Power Plants)
FHH, Fachhochschule Hannover, Hannover, Germany
Degree: Diplom Ingenieur 1989

Professional Experience:

2003- Present – President — Renk Labeco Test Systems Corp.
Mooresville, IN, USA
2000 - 2003 – Managing Director — Renk Labeco Test Systems Corp.
Mooresville, IN, USA
1995 - 2000 - Manager for sales and projection of test systems — Renk AG
Augsburg, Germany
1989- 1995 – Engineer Sales and projection of test systems — Renk AG
Augsburg, Germany

Publications: (up to 10)

Several patents on test stand components

Michael J. Drews / Clemson University / PI (N)

Education and Training:
University of Wisconsin-Madison, Chemistry, B.S., 1967.
University of North Texas, Physical Chemistry, Ph.D., 1971
Clemson University, Flame Retardant Chemistry, Post-doctoral, 1972-74.

Professional Experience:
Director, Clemson Conservation Center, School of Materials Science and Engineering, Clemson University, North Charleston, South Carolina, 2007 – present.
J. E. Sirrine Professor of Textiles, Fiber and Polymer Science, Clemson University, Clemson South Carolina, 1989 - 2006.
Scientist in Residence, Clemson University, Warren Lasch Conservation Center, North Charleston, South Carolina, 2002 – 2004.
Interim Director, School of Textiles, Fiber and Polymer Science, Clemson University, Clemson, South Carolina, 1997 - 1998.
Professor of Textile and Polymer Chemistry, Clemson University, Clemson, South Carolina, 1984 - 1989.
Associate Professor of Textile and Polymer Chemistry, Clemson University, Clemson, South Carolina, 1980 -1984.
Guest Worker, Center for Fire Research, National Institute for Science and Technology, Washington, D.C., Fall 1980.
Assistant Professor of Textile and Polymer Chemistry, Clemson University, Clemson, South Carolina, 1976 -1980.
Visiting Assistant Professor of Textile and Polymer Chemistry, Clemson University, Clemson, South Carolina, 1974 -1976.

Publications:
M. J. Drews, M. Williams and M. Barr, "The Corrosion of Sol –Gel Coated Type 316SS in Chlorinated SC Water," Ind. Eng. Chem. Res., 39, 4772 (2001).

M. J. Drews, M. Barr and M. Williams, "A Kinetic Study of the SCWO of a Sulfonated Lignin Waste Stream," Ind. Eng. Chem. Res., 39, 4784 (2001).

M. J. Drews, J. Wood and M. Wang, "Utilization of Moiré Interferometry to Study the Strain Distribution Within Multi-layer Thermoplastic Elastomers," J. of Biomaterials Sci., Polymer Ed., 13, 1051 (2002).

S. P. Ho, L. Reister, M. J. Drews, T. Boland and M. LaBerge, "Nanoindentation properties of compression-moulded ultra-high molecular weight polyethylene," Proc. Inst. Mech. Eng., 217[H2], 357 (2003).

S. P. Ho, P. F. Joseph, M. J. Drews, T. Boland, M. LaBerge, "Experimental and Numerical Modeling of Variable Friction Between Nanoregions in Conventional and Crosslinked UHMWPE," ASEE J. Biomechanical Eng. ASME J. Biomechanical Eng. 2004, 126:111-119.

N. González, P. de Viviés, M.J. Drews, and P. Mardikian. "Hunting Free and Bound Chloride in the Wrought Iron Rivets From the American Civil War Submarine H.L Hunley (1864)," J. of the American Institute for Conservation, 43, 161 (2004).

M. J. Drews , P. de Viviés, N. G. González, P. Mardikian, "A Study of the Analysis and Removal of Chloride in Iron Samples from the Hunley," Metal 2004, Proceedings of the International Conference on Metals Conservation, Canberra, Australia, October 2004, J. Ashton and D. Hallum, (eds.), Published by National Museum of Australia, Canberra, 247(2004).

D. Haynes, A.K. Naskar, A. Singh, C.-C. Yang, K.J. Burg, M. Drews, G. Harrison, and D. W. Smith, Jr., 'Poly(Lactic Acid) with Segmented Perfluoropolyether Enchainment', Macromolecules, 2007. 40, 9354-9360.

N. Gonzales, D. Cook, P. De Vivie´s, M. Drews and P. Mardikian, "The Effects of Cathodic Polarization, Soaking in Alkaline Solutions and Subcritical Water on Cast Iron Corrosion Products," Proceedings of the interim ICOM-CC Metal WG, Vol. 3, Amsterdam, ICCROM, 32 (2007).

P. De Vivie´s, D. Cook, M. Drews, N. Gonzales, P. Mardikian and J.-B. Memet, "Transformation of Akaganeite in Archaeological Iron Artefacts Using Subcritical Treatment," Proceedings of the interim ICOMCC Metal WG, Vol. 5, ICCROM, 26 (2007).

Synergistic Activities:

M. J. Drews, P. Mardikian, R. Marks, Cannon Stabilization and Architectural Coatings Treatment at Fort Moultrie, Southern Appalachian Cooperative Ecosystem Studies Unit, National Parks Service, 09/08-06/10.

M. J. Drews, S. Crette, O. Mefford, M. Kennedy, I. Luzinov, K. Kornev, V. Blouin, A. Mount and P. Brown, Surface modification for corrosion inhibition and the control of bio-film formation and bio-fouling in the marine environment.

M. J. Drews, N. Gonzalez, and D. Cook (Professor of Physics, Old Dominion University), The characterization of iron corrosion products formed in the marine environment using XRD, microprobe analysis and Raman and Mossbauer spectroscopy.

SHAWN J. GAFFNEY, P.E.
sgaffney@EcoEnergyLLC.com
EcoEnergy LLC • 2511 Technology Dr. Suite 110 • Elgin, IL 60124 • 815.266-4248 (T)

Education & Training

M.S. Electrical Engineering, University of Notre Dame, 1991
B.S. Electrical Engineering, University of Notre Dame, 1989
B.A. Physics, DePaul University, 1990
USAF Chief of Safety and Mishap Investigation Schools, 1997

Professional Experience

EcoEnergy LLC, EcoEnergy Engineers (IEE), Morse Energy LLC: **President,** In addition to managerial and technical responsibilities at IEE, conceived and launched three new Morse Group Companies: Elspec North America, EcoEnergy LLC and Morse Energy which have enhanced the Morse Group focus on specialty engineering, renewable energy systems and generating systems project management. Renewable Energy projects now cover a five state region with 100MW in operation, 375MW construction ready and 1500MW in development. 2002 - Present

Industrial Electrical Engineers Inc (IEE): **Vice-President,** responsible for transitioning the in-house engineering services at Morse Electric into a registered design firm offering design/build services directly to end use customers while still servicing the needs of Morse Electric. Shortly after its formation, the company began specializing in intelligent medium voltage distribution systems, electrical generation, cogeneration and protective relay design and build services. 1200MW of generation projects are in operation from these efforts. 1998-2002

Morse Electric, Inc: **Senior Electrical Engineer,** Electrical Design and Construction: Responsible for the design and/or review and approval of all designs for Morse Electric's four branch offices covering Illinois, Iowa and Wisconsin. Designs encompassed all aspects of commercial, industrial and utility electrical installations. This position led to the formation of Industrial Electrical Engineers Inc; A Morse Group Company. 1995-1998

ComEd: **Project Engineer,** Electrical design and construction engineering services for utility substation construction, SCADA systems, PLC controls and protective relaying systems. Responsible also for the interconnection testing and inspection of customer generating systems, analysis and resolution of industrial power quality problems and field engineering support for transmission and distribution system infrastructure improvements. Hand picked and successfully resolved power quality problems for the company's largest customer and received continuous "outstanding" rating during employment with the company. 1991-1995

United States Air Force / Air National Guard:, Instructor Pilot KC-135R on active flying status with periods of active duty for all major conflicts since 1994 with additional service as Chief of Safety at Chicago's O'Hare ANGB in 1997. Recipient of the Top Graduate Award for KC-135R pilot training. Top Secret Security Clearance by SSBI. 1992- Present

Patents and Publications of interest to Wind Energy:

Intellignet Power Collection Network, for wind and renewable generation systems, Patent Pending 2009 Shawn Gaffney, Rick Gungel and Ed Englert

Synergistic Professional Activities: Active member of AWEA, IEEE and NSPE

2446 Arlington Heights
Seneca, SC 29678

Phone W 656-5516;
H 653-3902
E-mail
galan@clemson.edu

Alan M. Godfrey

Objective

To provide fiscal oversight of Wind Turbine Drivetrain Test Facility project.

Summary of qualifications

- My education and experience in the private and public sector has not only given me a wide range of expertise in many areas, but has uniquely prepared me for this opportunity. My experience both externally and here at Clemson reinforce my belief that the core values of integrity, honesty, and accountability are the foundation on which lasting achievement is built. Early career experience with industrial construction and process equipment procurement management would be my greatest contribution to this project, with later experience managing the budget of the University augmenting the direct project experience.

Education

1975 – 1980 Clemson University Clemson, SC

BS Degree in Accounting

- Worked 20+ hours per week to support myself during school 1977-1980
- 20 years of professional development focused on higher education

July, 2007 – Present Clemson University Clemson, SC

Director of Real Estate and Financial Affairs, Clemson University Restoration Institute

- Responsible for the execution of the real estate plan for the North Charleston campus to include property transfers, lease outs, strategic negotiation with donor parties in compliance with the Transfer and Option agreement regarding the 100 acre waterfront campus.
- Responsible for the oversight and management of the financial affairs of the restoration institute to include safeguarding of assets, proper financial execution of the various institute budgets and activities.

July, 1992 – June, 2007 Clemson University Clemson, SC

University Budget Director

- Responsible for developing and managing the University's annual budget, in excess of $600 million at the culmination of this assignment, to include student fee strategy and projections, state revenue management, and the overall integrity and accountability of the university budget.
- Coordinate the integration of the total University resource plan with strategic and tactical plans from various planning areas of the campus, to guide the administration and unify the process into a cohesive, seamless effort.

September, 1991 – July, 1992 Clemson University Clemson, SC

Director of Financial Planning

- Developed the first comprehensive University five year Financial Plan.
- Developed the student fee revenue prediction model.
- Created a subcomponent of the enrollment model to facilitate projections of debt service revenues and debt retirement capacity.

January, 1989 – September, 1991 Clemson University Clemson, SC

Budget Supervisor

- Facilitated a major budget philosophy shift by developing a then state of the art activity based allocation and incentive models for the budget centers on campus. This was a major shift towards decentralized responsibility center management of the campus.

November, 1987 – January, 1989 U.S. Shelter Corp. Greenville, SC

Controller (Shelter Contractors)

- Total responsibility for financial operations and reporting of a $300 million per year subsidiary of U.S. Shelter Corp.
- Maintenance, reporting, and analysis of project fee earnings and coordinating activities with financial operations of the parent corporation.
- Management of the project costs, profits, and cash flows.

October, 1983 – November, 1987 Greenville County Greenville, SC

Director of Finance and Administrative Services

- Directly responsible for purchasing, accounting, human resources and general administrative services for a county wide special purpose district.
- Responsible for development and management of operating and capital budgets and interaction with county officials and the commission board.
- Primary staff liaison with the Board of Commissioners and County Council.

May 1980 – September, 1983 Flour-Daniel, Inc. Various Locations

Accountant / Project Accountant / Task Force Accountant

- TF Accountant – Responsible for cash forecasting and industrial capital equipment financial execution of a $450 million manufacturing project; Greenville, SC and Russellville, KY 1981-83.
- Project Accountant – Sole responsibility for a $10 million fast track manufacturing plant expansion project; Jacksonville, Florida 1980-81.
- Accountant – Project cost ledgers and payroll for a $250 million plant expansion; Rumford, Maine 1980.

Hobbies are outdoor activities such as water sports, fresh and salt water fishing and hiking. Also active in neighborhood association service, volunteerism and other activities.

Stephen T. Hung
Associate Professor
Clemson University
Department of Mechanical Engineering, Clemson, South Carolina, U. S. A.
International Center for Automotive Research, Greenville, South Carolina, U. S. A.
Office: 864.283.7224 / Email: sthung@clemson.edu

Education and Training:

University of Tennessee, Knoxville, TN — Electrical Engineering — B.S.E.E. (1983)
Senior concentration: Systems and networks. Minor: Pre-Medical.

University of Illinois, Urbana, IL — Electrical Engineering — M.S. (1985)
Thesis title: *Multi-input/Multi-output Sensitivity Points Tuning*. Advisor: P. V. Kokotovic.

University of Illinois, Urbana, IL — Electrical Engineering — Ph.D. (1989)
Thesis title: *A Design Methodology for Self-tuning Control of Systems with Conflicting Oscillatory Modes*. Advisor: P. V. Kokotovic.

Research and Professional Experience:

1. 2007-present, Associate Professor, Department of Mechanical Engineering and International Center for Automotive Research, Clemson University, Clemson, SC.

   Teaching and research in automotive engineering, with research emphases in system integration methods and application of those methods to (i) waste energy minimization, recovery, and re-use; and (ii) non-contact, on-the-move infrastructure-to-vehicle energy transfer.

2. 2005-2007, Program Manager, Cross-System (Climate, Electronic, and Interior Systems) Advanced Product Development, Visteon Corporation, Van Buren Township, MI.

   Program management of advanced cross-system technology development efforts that cut across interiors, electronics, and climate/thermal management product areas. Assignments included on-time, in-budget, on-target delivery of Visteon's portion of the USDOE-sponsored Thermoelectric Waste Energy Recovery System development program jointly undertaken by BSST, Visteon, and BMW. Coordinated engineering efforts between Visteon engineering staffs in Michigan, Germany, and Czech Republic.

3. 1998-2004, Manager for Electric, Electrohydraulic, and Hydraulic Steering Systems Advanced Product Development, Visteon Corporation, Dearborn, MI.

   Formation and leadership of technology development groups for vehicle steering technologies that minimized vehicle-level propulsion system losses at market-competitive package, weight, pricing, and quality. Coordinated concurrent worldwide steering advanced technology development efforts between engineering groups in Michigan, Germany, Mexico, and Brazil.

4. 1995-1998, Research Engineer, Customer Vehicle Data Acquisition System Development, Global Test Operations, Ford Motor Company, Dearborn, MI.

   Architect and development leader for the system Ford still uses worldwide today for long-term, remote data acquisition and reporting of vehicle usage information from their customers' vehicles.

5. 1992-1995, Product Development Engineer, Formula 1 Vehicle Control Electronics, Ford Motor Company, Dearborn, MI, and Enstone, Oxfordshire, UK.

   Algorithm development leader and provider of on-site traction control system integration engineering support, including dynamometer-level integrated powertrain testing oversight, full-vehicle test design and oversight, and associated data acquisition and analysis for the Benetton-Ford B193B race car. Provider of on-site system integration of the Ford Formula 1 Powertrain Electronics Integrated Test System, which allowed real-time, Hardware-In-the-Loop, dynamic desktop testing of powertrain control modules prior to their installation into the Benetton-Ford B194 race car.

6. 1991-1992, IPA Scientist, Advanced Electric Propulsion Technology Thrust, Naval Undersea Warfare Center, U. S. Navy, Newport, RI.

   Development of adaptive/self-tuning controls for propulsion/driveline systems to maximize performance while minimizing undesirable acoustic/vibrational emissions.

7. 1988-1992, Assistant Professor, Department of Electrical Engineering, Auburn University, Auburn, AL.

   Teaching and research in electrical engineering, with emphasis in industrial and embedded electronic system design.

Publications (related to energy efficiency, energy-efficient systems, and energy management):

1. U. S. Patent No. 7,467,605, *Thermal Energy Recovery and Management System* (awarded to Visteon Global Technologies Inc. in 2008 for joint invention by Norman Szalony and Stephen T. Hung).
2. J. W. LaGrandeur, D. T. Crane, A Eder, and S. T. Hung, "High efficiency waste energy recovery system for vehicle applications," *Proceedings of the 25th International Conference on Thermoelectrics (ICT-2006)*, Vienna, Austria, August 2006.
3. J. Y. Hung and S. T. Hung, eds., "Special Section on Automotive Electronic Systems," *IEEE Transactions on Industrial Electronics*, vol. IE-51, no. 2, April 2004.
4. U. S. Patent No. 6,899,528, *Power Steering Pump* (awarded to Visteon Global Technologies Inc. in 2005 for joint invention by Brian Youngpeter, Dale C. Killins, Stephen T. Hung, Timothy M. Staton, and Scott L. Radabaugh).
5. U. S. Patent No. 6,644,134, *Flux Brush Torque Sensor* (awarded to Visteon Global technologies Inc. in 2003 for joint invention by Bruce A. Bowling, John F. Laidlaw, and Stephen T. Hung).
6. D. C. Hopkins, C. R. Mosling, and S. T. Hung, "Dynamic Equalization during Charging of Serial Energy Storage Elements," *IEEE Transactions on Industry Applications*, vol. IAS-29, no. 2, March-April 1993.
7. S. T. Hung, D. C. Hopkins, and C. R. Mosling, "Extension of Battery Life via Charge Equalization Control," *IEEE Transactions on Industrial Electronics*, vol. IE-40, no. 1, February 1993.

Synergistic Activities:

1. Revision (Spring 2009) of the team-taught *AuE 882 System Integration Concepts & Methods*, a graduate-level course of the Clemson University International Center for Automotive Research's graduate curriculum that seeks to familiarize students with system integration/engineering methods in common automotive industry use (e.g., Hatley-Pirbhai functional decomposition and partitioning, Failure Mode Effects Analysis and related Design Verification Planning).
2. Fall 2008 revision of the team-taught *AuE 880 Leadership and Project Management,* a graduate-level course of the Clemson University International Center for Automotive Research's graduate curriculum that seeks to familiarize students with concepts of leadership and project management, particularly with respect to advanced/new product/process development in the automotive industry.
3. Keynote speaker, 2008 *IEEE International Workshop on Factory Communication Systems*, Dresden Germany, May 2008. This speech described the similarities between factory and automotive vehicle communication technologies, as well as how the two can and have been synergistically developed to demonstrate new-technology viability and spread the amortization of development costs.
4. Plenary session speaker, *2001 IEEE/ASME International Conference on Advanced Intelligent Mechatronics - AIM '01*, Como, Italy, July 2001. This speech described the similarities between automotive and industrial mechatronics and how an open system interconnection description, similar to that used to streamline description of software and/or communication subsystem functionalities, can be useful as a common functional partitioning language in developing mechatronic systems.

John W. Kelly, Fellow ASHS
Vice President PSA, Clemson University
Clemson, SC 29634
Executive Director, Clemson University Restoration Institute
1360 Truxton Ave, North Charleston, SC
Phone: 864-656-3642 email: jkelly@clemson.edu

Education and Training:

Clemson University	Horticu	lture (1977)
Ohio State University		Horticulture M.Sc. (1979)
Ohio State University	Horticulture	Ph.D. (1982)

Research and Professional Experience:

Clemson University, Vice President (1997 to present), Clemson, SC

- Serve as State Agency Head, Clemson University Public Service Activities
- Serve as one of the three Mission Vice Presidents for the University assisting and coordinating in the development, funding and implementation of the university goals and long range plans
- Manage annual operating budget of approximately $95,000,000 and approximately 800 FTE faculty and staff.
- Serve as Director of SC Experiment Station coordinating research programs and providing funding for ~ 112 faculty
- Serve as Director of Cooperative Extension Service managing offices in all 46 counties in SC.
- Provide oversight for two regulatory units
- Manage 55 off-campus locations for the university including 8 Research and Education Centers.

Clemson University Restoration Institute, Executive Director (2006-present)

- Coordinate activities, land development, program implementation for new 91-acre research campus on the former Navy Base in North Charleston, SC

Clemson University, School Director (1996-1997)

- Serve as director of School with 5 Academic Departments
- Manage budget, coordinate and evaluate approximately 80 faculty members with teaching, research and extension responsibilities

Clemson University, Professor and Department Chair (1991-1995)
Clemson University, Associate Professor, (1985-1991)
Texas A&M University, Assistant Professor, (1982-1985)

Professional Activities:

American Distance Education Consortium- Chairman of Board (2004-2008)

- Consortium for approximately 70 universities

SC Sea Grant Consortium Board of Directors (1997-present)

- Consortium of 7 universities and agencies

National Association of State Universities and Land Grant Colleges. Administrative Heads Section, Executive Committee 2006-present, Chair 2008-2009

- Consortium of 214 universities.

Clemson University Research Foundation- Board of Directors (2007-present)

Clemson University Foundation- Campaign Leadership Committee (2008-present)

President and Chair of the Board for ASHS (1999-2000)

Synergistic Activities:

Eighteen years of experience in managing faculty and staff, personnel hiring, fundraising and project management.

Published over 50 peer reviewed journal articles during prior to administrative career

Responsibility for 8 Research and Education Centers located off-campus

Directly involved in management of university's 31,000 acres of land

Directly involved in the recent construction of 3 new off-campus research buildings in the past 3 years with 2 more in the planning stages.

MICHAEL D. MESSMAN P.E.

Research Engineer
Clemson University International Center for Automotive Research
4 Research Drive, Greenville, SC 29607
phone: (864) 283-7213 email: mdmicar@clemson.edu

Education and Training:

- Master of Science, University of Nebraska, 1986, Engineering Mechanics
- Bachelor of Science, University of Nebraska, 1984, Mechanical Engineering

Professional Experience:

Clemson University International Center for Automotive Research, Greenville, SC (March 2007 – Present)
Research Engineer in charge of operations, test development, and supervision of technicians at the newly completed testing laboratories located within the Carrol A. Campbell Graduate Engineering Center. Laboratory equipment includes a chassis dynamometer housed in an anechoic chamber, a 7-post road simulator housed in an environmental chamber, a 580 HP engine dynamometer, a full vehicle coordinate measurement machine, an electromagnetic compatibility chamber, a machine shop, and associated instrumentation and data acquisition equipment. The laboratory supports faculty and graduate student research projects and also provides testing services to outside companies. Have played a key role in setting up operations of the laboratory including hiring the technician staff and specifying/ordering instrumentation and sensors.

John Deere Technology and Innovation Center, Moline, Illinois (June 1997-March 2007)
Staff Engineer and leader of technical development projects at the Accelerated Design Verification Laboratory. These projects supported an integrated product verification and validation process comprised of measurement engineering, servo-hydraulic testing, multi-body dynamics computer simulations, and finite element analysis. Expert in measuring and analyzing dynamic loads data from complex machinery and correlating the data to results of computer simulations. Designer of custom multi-axial force transducers including rotating wheel force transducers. Designed and developed a five-axis wheel force/moment transducer system, which has been successfully applied to the full range of Deere products from lawn and garden equipment to combines and four wheel drive tractors.

Corporate-wide consultant to measurement and test engineers, providing assistance and problem solving support. Instructor and developer of an internal 2-1/2 day course on measurements and data analysis. Developed a practical method to measure on-and-off-road terrain profiles that are used for input to multi-body dynamics simulations. Developed a tire testing methodology to generate dynamic tire stiffness and damping properties. Frequently traveled to domestic and international factories and field sites to conduct measurement projects and training.

Supervised an instrumentation group responsible for production and support of an in-house digital data acquisition system and then later led a corporate transition to commercially available systems.

General Motors Proving Ground, Milford, Michigan (June 1986-June 1997)
Senior Project Engineer involved in a variety of structural test and measurement projects. Conducted structural durability evaluations related to product safety issues utilizing fatigue and failure analysis, on-board vehicle measurements, servo-hydraulic testing, test fixture design, and experimental stress analysis. Projects frequently involved the estimation of field reliability from proving ground measurements and laboratory testing. Presented test results to product recall committees.

Designed and developed a six-axis wheel force/moment transducer that has become a standard measurement and test tool at GM. More than 100 of these transducers have been built, saving at least $5 million over the cost of commercial transducers. Managed all facets of the wheel transducer project, which also included the development of electronics, calibration fixtures, data processing algorithms, and operational procedures.

Professional Activities:

- Member of SAE Tire Tests for Road-Load Tire Model Parameters Task Force (current)
- Chair of Fatigue Life Prediction Division of the SAE Fatigue Design and Evaluation Committee (1994-1996)
- Iowa Professional Engineer (2004 – present)
- Member of Society of Experimental Mechanics (1989-2003)
- Contributor to Society of Experimental Mechanics "Handbook on Structural Testing"
- GM Corporate liaison for the University of Illinois Fracture Control Program

Skills and Abilities:

- Twenty three years of automotive and off-road equipment engineering experience in measurements and testing in support of structural durability, product development, problem solving, and research.
- Experienced in developing accelerated fatigue correlated durability tests including measurement and interpretation of duty cycle loads, data editing, drive file creation, and test fixture design.
- Experienced in supporting and improving computer-based analysis through correlation of results with measurements and experimental determination of key inputs and system properties
- Highly skilled in the measurement, analysis, and interpretation of test data
- Expertise in obtaining input loads for FEA, dynamic models, and servo-hydraulic durability tests
- Thorough understanding of test and measurement equipment and techniques
- Hands-on experience and in-depth knowledge of measurement systems and transducers, including the ability to design and build custom strain gage based load transducers and instrumented components
- Expertise in the design and use of wheel force transducers
- Very knowledgeable in metal fatigue analysis and testing
- Supervisory experience
- Effective project manager

NICHOLAS C RIGAS
Facility Director, Clemson University Wind Turbine Test Facility

Education and Training:

Washington University, St. Louis, MO	Chemical Engineering, D.Sc. (1991)
Kansas State University, Manhattan, KS	Chemical Engineering, M.Sc. (1988)
University of Missouri, Rolla, MO	Chemical Engineering, B.Sc. (1984)

Research and Professional Experience:

EcoEnergy LLC, Vice President (02/2008 to Present) Elgin, IL

- Managing engineering and development team focused on more than 3000 MW of wind projects in six states with 12 direct reports and annual budget of over $2M.
- Directing energy assessment activities for wind projects under development.
- Awarded contract by US DOD ANG to conduct renewable energy assessments of selected bases.
- Leading business development activities with utility partners on wind projects.
- Negotiating power purchase agreements and interconnection.

Clemson University, Assistant to Vice President, Clemson University Restoration Institute, Adjunct Professor (02/2008 to Present) Charleston, SC

- Leading state wide team to establish renewable energy cluster in South Carolina.
- Developed model for wind industry manufacturing cluster with focus on private/public partnership.
- Developing biofuels program in partnership with SRNL and Private Partners.
- Led team of professors to identify cluster hires for biomass research program.
- Established long term partnership with GE Energy, Duke Energy and Santee Cooper for future renewable energy related application research.
- Assisted in development of Consortium for Large Offshore Wind Turbine Technology Proposal submitted to US DOE that included 8 universities and major US Turbine Manufacturer.

Clemson University, Director, South Carolina Institute for Energy Studies, Clemson University (02/2006 to 02/2008) Clemson, SC

- Served as Director of State Energy Institute with the mission to develop state's indigenous clean energy resources to promote economic development , a cleaner environment and sustainability with an annual budget > $3.6M and 11 employees.
- Led study to assess wind potential at three coastal locations utilizing 50M met stations in partnership with Santee Cooper, Savannah River National Laboratory and CCU.
- Led team to develop sustainable biofuels program for state of South Carolina in cooperation with SRNL, SC State University, Fagan Engineering, Spinx Corp. and other partners.
- Chaired team that established SC Biomass Council and served as Chairman.
- PI for $200K feasibility study of offshore wind energy development for a South Carolina utility company.
- PI $400K program to test new generation SODAR to evaluate coastal and offshore wind conditions in partnership with Savannah River National Laboratory, Coastal Carolina University and Santee Cooper Utility.
- PI for DOE NETL University Turbine Systems Research Program. ($2.5M/yr)
- PI for $75K Stationary Fuel Cell Technology and Market Analysis Project for the SRNL.
- PI for $800K federal Hydrogen Fueling Station infrastructure project.

FMC Corporation Lithium Division: Division Director of Technology and Operations.

(11/2000 – 02/2006) Charlotte, NC

- Managing di rector of Technolog y and Operations Departments for a $200M worldwide lithiu m chemicals business with over 150 prof essional and 400 hourly personnel in r esearch, developm ent, operations, logistics and production planning with an annual budget of > $110M.
- Managed research teams focused on development of lithium ion battery m aterials and synthetic intermediate reagents
- Managed start-up of Synth etic Intermed iates Pilot Plant, Industrial Interm ediates Plant and Battery Materials Testing Center valued at over $35M.
- Led business development team for expansion of business into India and China.
- Implemented m anufacturing strategy t hat led >$10M in annual savings utilizing Six Sigma, Lean manufacturing principals and production planning procedures.
- Led team that developed environmental remediation plans for UK and NC operations.
- Implemented novel technology to reduce emissions saving nearly $2M in capital and $1M annually.
- Developed strategy to utili ze natural gas 'Virtual Pi peline' to offset oil i mports at Argentine mining facility saving company over $5M annually in operating expenses. .

FMC Corporation Lithium Division: Plant Manager
(07/1998 – 11/2000) Bessemer City, NC

- Responsible for health, safety , enviro nmental, pr oduction, m aintenance, logistics, purchasing, and capital spending for a chemical plant with over 2 50 employees; $30M annual operating budget and > $10M annual capital budget.
- Managed implementation of ISO2001 certification of site.
- Developed and im plemented restructuring plan that reduced pay roll by 40% while inc reasing production and saving nearly $5 M annually in operating costs.
- Developed and executed plan that reduced air e missions from plant b y 80%, safely disposed of 2 0+ years of highly reactive waste and capped two on site landfills.
- Led demolition and environmental remediation program for two production plants in NC.

American Home Products: Engineering Manager (07/1997 – 07/1998) Hannibal, MO
FMC Corporation Lithium Division: Manufacturing Manager (06/1995 – 07/1997)
FMC Corporation Process Additives: Operations Manager (06/1992 – 06/1995)
Texas Instruments: Process Development Manager (05/1984 – 08/1986)
US Navy Reserves, LT (03) Naval Mobile Construction Battalions 15, 20, and 24, 1987-1996,

Synergistic Activities:

- Representing South Carolina on AWEA Offshore Wind Subcommittee
- Representing Clemson University on Santee Cooper, Palmetto Winds Offshore Wind Project
- Representing Clemson University on South Carolina Offshore Wind Regulatory Review Committee
- Organizing South Carolina Offshore Wind Working Group

GEORGE R. TRASK

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Education:

LAWRENCE TECHNICAL UNIVERSITY — Southfield, MI
Bachelor of Science, Industrial Management 1981

LAWRENCE TECHNICAL UNIVERSITY — Southfield, MI
Associate of Science, Mechanical Engineering 1969

GENERAL MOTORS INSTITUTE — Flint, MI
Co-op Student – Mechanical Engineering 1963-1964

GENERAL MOTORS CORPORATION — Pontiac, MI
Journeyman Tool and Die maker 1968-(apprentice completed)

Professional Experience:

2000-Present **PILGRIM ASSOCIATES** — Anderson, SC
President – A Management Consulting Company
This company services clients in Canada, Michigan, Kentucky, Tennessee and South Carolina.
2004 to present-Project Manager of Clemson University-ICAR-International Center for Automotive Research-$52M greenfield facility with major equipment of $12.5M.

1999-2000 **MONROE AUTOMOTIVE EQUIPMENT** — Hartwell, GA
A division of Tenneco Automotive
Project Manager, Stamping Outsourcing Program

1996-1999 **WALKER MANUFACTURING** — Elkhart, IN
A division of Tenneco Automotive
Project Manager for New Plant Construction for a Stamping and Hydroforming Plant

1995-1996 **BENTELER INDUSTRIES - GOSHEN PLANT** — Goshen, IN
U.S. Division of a German automotive system manufacturing compan.
Business Unit Manager, Door beams (1995)
Technical Services Manager (1994)

1994-1995 **Magna International** — Williamsburg, IA
Assistant Plant Manager-245 employees

1991-1994 **STOLLE CORPORATION** — Sydney, OH
A division of Alcoa Aluminum
Central Engineering Manager-400 employees

1981-1991 **BENDIX AUTOMOTIVE SYSTEMS**
A division of Bosch Automotive Systems (formerly Allied Signal Corporation)
Operations Manager – Master Vac, (1988-1991) **Sumter, SC**
Technical Services Manager, (1984-1988)-2 new plant constructions

General Supervisor, Manufacturing Engineering (1981-1984) **South Bend, IN**

1969-1981 **FORD MOTOR COMPANY** **Dearborn, MI**
Senior Division Manufacturing Engineer (1976 – 1981)
Stamping Manufacturing Engineer (1969-1976)

Publications:

1997 **"Ssssh! Stamping in Progress", *Automotive Industries,* November 1997**

1997 **"Mirrored Scrap Handling System", *Metal Forming Magazine,* December 1997**

Synergist Activities:

2004-2008 CU-ICAR New facility construction: Project Manager for Clemson University International Center for Automotive Research facility that included 5 advanced test cell: 500 HP Full vehicle chassis dynamometer with a Hemi-Anechoic chamber, containerized 500 HP Engine and power train dynamometer with fuel farm, 7 post full vehicle shaker in a climate chamber, full vehicle drive on coordinate measuring machine with 2 digital automatic arms, EMC vehicle chamber with turn table. Total equipment cost of $12.5M with $3.5M of foundation and installation cost.

Paul J. Venhovens
BMW Endowed Chair in Automotive Systems Integration
Department of Mechanical Engineering
Clemson University International Center for Automotive Research
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Greenville, South Carolina, USA
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Education and Training

Delft University of Technology, Department of Mechanical Engineering, Delft, the Netherlands, Section for Vehicle Dynamics and Mechatronics, M.Sc. (1989)
Delft University of Technology, Department of Mechanical Engineering, Delft, the Netherlands, Section for Vehicle Dynamics and Mechatronics, Ph.D. (1993)

Research and Professional Experience

2008-present	Clemson University ICAR, BMW Endowed Chair in Automotive Systems Integration.
2004-2008	BMW R&D, Munich, Functional Concept Design, Senior Development Engineer
2000-2004	BMW R&D, Munich, Dept. for Noise, Vibrations and Harshness, Senior Development Engineer Driveline and Chassis
1999	BMW Technology Office, Palo Alto CA, Driver Assistance Systems, Development Engineer
1995-1998	BMW R&D, Munich, Vehicle and Traffic Research, Development Engineer
1993-1995	University of Michigan Transportation Research Institute, Ann Arbor, Postdoctoral Researcher

Publications

1. Marshall Saunders, Steve Hung, **Paul Venhovens**, "End-user Perspectives of Challenges Facing Vehicle-to-Grid Integration", Power Systems 2009 Conference, Advanced Metering, Protection Control, Communication and Distributed Resources, Clemson University, 2009
2. Arthur P. Hülsmann, **Paul J. Th. Venhovens**, Franz Froschhammer, "Optimization of the Load Reversal Phenomena based on Virtual Non-Linear Powertrain Models", International Symposium on Advanced Vehicle Control (AVEC '04), August 23-27, 2004, Arnhem, The Netherlands.
3. Roscher, T., **Venhovens, P.**, "Identification of Rubber Bushings", International Conference on Noise & Vibration Engineering, ISMA 2002 Conference, 16-18 September 2002, Leuven, Belgium.
4. Robert Ervin, Zevi Bareket, Paul Fancher, John Sullivan, Paul Venhovens, "Altercontrol: A Tool for the Methodical Engineering of Driver Assistance Systems". International Symposium on Advanced Vehicle Control (AVEC '02), September 9-14, 2002, Hiroshima, Japan.
5. **Paul Venhovens**, Thomas Bachmann, Karl Naab, Michael Schraut, "BMW's Driver Assistance Concept for Integrated Longitudinal Support", 7th World Congress on ITS, 6-9 November 2000, Turin, Italy.
6. **Paul Venhovens**, Karl Naab, Bartono Adiprasito, "Stop and Go Cruise Control", FISITA World Automotive Congress, F2000I396, June 12-15, 2000, Seoul, Korea. International Journal of Automotive Technology, Volume 1, Number 2

7. **P.J.Th. Venhovens**, J.H. Bernasch, J.P. Löwenau, H.G. Rieker, M. Schraut, "The Application of Advanced Vehicle Navigation in BMW Driver Assistance Systems", SAE International Congress and Exposition, 1999-01-0490, Detroit, Michigan, USA.
8. **Paul J.Th. Venhovens**, Karl Naab, "Vehicle Dynamics Estimation Using Kalman Filters", International Symposium on Advanced Vehicle Control (AVEC '98), 9836617, September 14-18, 1998, Nagoya, Japan.
9. D.J. LeBlanc, G.E. Johnson, **P.J.Th. Venhovens**, G. Gerber, R. DeSonia, R.D. Ervin, C.F. Lin, A.G. Ulsoy, T. Pilutti, "CAPC: An Implementation of a Road-Departure Warning System," Proc. Fifth IEEE Int. Conf. on Control Applications, Sept. 1996, Dearborn, MI.
10. R. Ervin, G. Johnson, **P. Venhovens**, C.C. MacAdam, A.G. Ulsoy, D.J. LeBlanc, C.F. Lin, H. Peng, C.S. Liu, G. Gerber, R. DeSonia, "The Crewman's Associate for Path Control (CAPC): An Automated Driving Function", Final Report to U.S. Army TACOM for Contract No. DAAE07-93-C-R124, Sept. 1995.

Synergistic Activities

- Extensive experience in chassis and driveline simulation and testing, including hardware-in-the-loop modeling and control of (virtual) vehicle drivelines using (hardware) engine dynamometers with the aim to optimize driveline parameters (such as stiffness, damping, inertia and backlash) and ECU control parameters in a combined approach for optimal driveability.
- Broad experience in modeling and model validation of full physical drivelines built-up as subsystems (separated from a typical vehicle body) on a chassis dynamometer. Application of modal analysis and signal processing techniques for parameter identification and model validation purposes.
- Broad experience in Transfer Path Analyses to determine propagation of noise and vibrations in driveline, chassis and load baring structures including balancing structure-borne noise contributions for acoustic target achievement.
- Extensive Experience with Multi-Body-Simulation techniques for dimensioning of driveline components and derivation of subsystem and component requirements.
- Member of the International Scientific Committee, International Association of Advanced Vehicle Control (AVEC).

Name of Applicant: Clemson University

Principal Investigator: Dr. Imtiaz Haque

Project Title: Clemson University Wind Turbine Drivetrain Test Facility DE-FOA-0000112

Project Objective: 1. Design, develop, and implement a state-of-the-art sustainable facility that permits full-scale highly accelerated lifetime (HALT) testing of advanced drivetrain systems for large wind turbines. 2. Meet the objectives of the American Recovery and Reinvestment Act of 2009 by creating jobs in an economically distressed area of the U. S. and assist in the economic recovery in an expeditious manner.

Project Description: Clemson University proposes to engineer, construct and operate a Wind Turbine Drivetrain Test Facility (CU WTDTF) for highly accelerated testing of drivetrains for wind turbines up to 15MW with a 30% overload capacity. The primary team on the project includes Clemson University, Clemson University Restoration Institute (CURI), City of North Charleston and Charleston, Charleston Naval Complex Redevelopment Authority, the Savannah River National Laboratory and the State of South Carolina.

The facility will be located in Building 69 at the Charleston Naval Complex, a former DOD Naval base in North Charleston, S.C. It will be a part of the CURI campus. Building 69 has access to shipping by water, road and rail, and has potential for expansion. Building 69 will have two test bays, overhead cranes for moving equipment, office and other spaces for personnel and instrumentation. A rail spur will facilitate the delivery and departure of drivetrain units. The port has infrastructure that provides loading and unloading of drivetrains, machine shop facilities and access to more office space.

The facility will consist of two test rigs equipped with independent drive systems. Both test rigs will be capable of testing, simultaneously a 7.5 MW drivetrain and a 15 MW turbine drivetrain. A climate chamber and sound separation system will be available for use on either rig. Rig #1, which will have the capability to apply loads to the main shaft of the specimen drivetrain, replicating forces and moments along three orthogonal axes thereby simulating actual blade forces experienced in the field.

The test facility will operate under a 'shared' model as a non-profit organization with a business model designed for sustainability while providing ongoing state-of-the-art testing to wind turbine manufacturers. The facility's primary mission is to service the wind industry with secondary missions of promoting industry/government/university collaboration in research and workforce education. The facility will be manned with a dedicated workforce to service industry needs with additional services offered by established local industries as needed by customers. Clemson University will establish an experienced team to ensure proper execution of the project and its safe operations. It is anticipated that facility over the next 20 years will serve as the catalyst for a wind industry cluster to form at the Charleston Naval Complex due to the unique industry/research environment at a brown-field site near existing port, rail infrastructure and supporting industries. 113 temporary jobs associated with the construction of the facility will be created in the first three years, 21 full time operational jobs will be created. Another 150 jobs from the manufacturing cluster that will arise around the facility and 568 indirect jobs will be created for a total of 852 jobs during the period of this proposal.